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ENVIRONMENTAL ASSESSMENT

IRRIGATION REHABILITATION

REPORT

GEORGIA MUNICIPAL INFRASTRUCTURE AND IDP HOUSING REHABILITATION PROJECT

CONTRACT: AID-EDH-I-00-08-00027-00, TASK ORDER: AID-114-TO-11-00002

DCN: 2010-GEO-033

January 2012; Revised 20 February 2012

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

TETRA TECH

February 20, 2011

Mr. Bradley Carr
Water Irrigation and Infrastructure Advisor
Office of Economic Growth
US Agency for International Development
11 George Balanchine Street
Tbilisi, 0131
Georgia

Re: Revised Environmental Assessment for Irrigation Rehabilitation Activities

Dear Mr. Carr:

This report is being submitted to you in accordance with the requirements of task order no. AID-114-TO-11-00002 of contract AID-EDH-I-00-08-00027-00. It provides Tetra Tech's Revised Environmental Assessment for Irrigation Rehabilitation Activities to include BEO comments.

We look forward to your review and welcome your comments and suggestions.

Very truly yours,

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CC: USAID (George Kokochashvili); MDF (Kartlos Gviniashvili); Tetra Tech (Firouz Rooyani, Dean White, Tom Chicca, Ilia Eloshvili)

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ABBREVIATIONS AND ACRONYMS

ARWR	Actual Renewable Water Resources
BEO	USAID Europe and Eurasia Bureau Environmental Officer
CFR	Code of Federal Regulations
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMMP	Environmental Mitigation and Monitoring Plan
EPI	Economic Prosperity Initiative (USAID Project)
ESS	Environmental Scoping Statement
Geo	Geo Ltd
GMIP	Municipal Infrastructure And IDP Housing Rehabilitation Project (the project)
GoG	Government of Georgia
IDP	Internally Displaced Persons
IRWR	Internal Renewable Water Resources
Kav	Kavgiprotransi-Mg Ltd
M&E	Monitoring and Evaluation
M&M	Mitigation and Monitoring
MDF	Municipal Development Fund
MEO	USAID/Georgia Mission Environmental Officer
MLHSA	Ministry of Labor Health and Social Affairs
MRA	Ministry of Refugee Affairs
MRDI	Ministry of Regional Development and Infrastructure
NEO	New Economic Opportunities (USAID Project)
NGO	Non-Government Organization
PMP	Performance Monitoring Plan
SOW	Scope of Work
TBD	To Be Determined
TOCOTR	USAID Task Order Cognizant Technical Officer
Tt	Tetra Tech EM Inc.
USAID	United States Agency For International Development
USG	U.S. Government
WB	World Bank

1. Summary

The Government of Georgia (GoG) identified the Tiriponi and Saltvisi irrigation schemes in Shida Kartli Region as priority targets for USAID technical assistance. These systems were impacted by Georgia's 2008 conflict with Russia. Both schemes previously received water from the same head works located on the Didi Liakhvi River at Tskhinvali. The head works is now in the occupied zone and flow to the two schemes was cut-off in 2008. To adjust to this situation GoG constructed a new diversion dam and pumping station at Kvemo Nikozi, several kilometers downstream of the old head works. The new pump station has six pumps and a seventh will begin operation in 2012. For the GMIP rehabilitation project, six pumps will serve Tiriponi and one will serve Saltvisi.

GMIP expects to fund up to $8.1 million on the irrigation infrastructure for these two schemes. The rehabilitation is expected to impact about 18,000 hectares of rural land, restoring productive capacity and helping more than 20,000 small farmer households to increase agricultural productivity. The activities include rehabilitation of the main canals of Tiriponi irrigation system (8,500 ha) up to the first crossing with the occupied territory, rehabilitation of the Karbi Headworks and rehabilitation of the main canals in the Saltvisi irrigation system (9,700 ha). The expected number of beneficiaries is 9,790 farmer households in Tiriponi and 11,080 in Saltvisi. Over 10,000 of these households are IDP families.

1.1 Description of the Project

The primary source of water for the Tiriponi irrigation system is the pump station at Kvemo Nikozi. A second source of irrigation water is the Patara Liakhvi River gravity flow diversion structure at the existing Karbi Headworks. The Tiriponi rehabilitation is divided into three phases. The USAID project will rehabilitate the first phase which includes Karbi Headworks, the main canal from Karbi to the point at which main canal crosses into occupied territory and several canal structures (one gallery, 2 tunnels, 3 aqueduct, and 4 siphons). The Tiriponi rehabilitation includes about 60 km of irrigation channels (G-1, G-1-1, G-1-2, G-1-3, G-2, G-3, G-3-1 and G-3-1-6) that will provide irrigation water to 8,500 ha. The channels included in the Tiriponi rehabilitation are shown in Figure 3.1, Map 2 (above the Didi Liakhvi River, channels in red).

The Saltvisi system receives water from the Kvemo Nikemo diversion dam on the Didi Liakhvi River via two sources: a) from the Tiriponi pump station located on the left bank and b) through a gravity intake regulator on the right bank. Water from the Tiriponi station is pumped 3 km through a new pipeline. The Nikozi gravity off-take on the right bank and a second downstream off-take channel convey water into the Dzlevisjvari channel. The GMIP rehabilitation includes about 45 km of irrigation channels ((G-1, G-1-1, G-2 and the former Dzlevisjvari channel) that will provide irrigation water to 9,700 ha. The channels included in the Saltvisi rehabilitation are shown in Figure 3.1, Map 2 (below the Didi Liakhvi River, channels in red).

Karbi Headworks: For Karbi Headworks proposed rehabilitation includes removal of sediment, restoring concrete on the diversion dam and intake, bank protection works, cleaning the riverbed, restoring the flushing galleries, arrangement of a trash-rack for the head works, restoring/repairing the regulating gates, replacing and providing mechanical and electrical systems for lifting of gates, providing on-site housing for the operator, constructing a fish by-pass, and installing flow measurement capability.

Tiriponi: For Tiriponi, activities include cleaning channels of vegetation and sediment to make them hydraulically efficient; repairing and improving the linings of damaged sections of channels to make them water-tight and hydraulically efficient; determining and eliminating points of excess channel seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

Saltvisi: For Saltvisi, activities include cleaning channels of vegetation and sediment; restoring and shaping the channel in earth-lined sections; lining the bed and slopes of the channel in proposed lined sections; repairing and improving the linings of the damaged sections of the lined channels to make them more water-tight and hydraulically efficient; determining and eliminating points of excess canal seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

1.2 Project Context

GMIP addresses needs resulting from Georgia's August 2008 conflict with Russia and the global economic downturn that has challenged Georgia's economic stability. These needs have placed a severe strain on Georgia's national budget and its ability to finance core investments in critical regional development initiatives like irrigation. Many years of decline in the quality, coverage and maintenance of irrigation systems have dramatically reduced Georgia's quality of life in rural areas and constrained private sector growth. Such degradation and instances of conflict-related damage have resulted in significant constraints to the productive capacity and quality of life of thousands of Georgians.

1.3 Summary of 22 CFR 216 Requirements, IEE Summary, Scoping Process

USAID's environmental regulations (22 Code of Federal Regulations 216 or Reg. 216) establish the conditions and procedures for environmental review. These procedures apply to new projects, programs, or activities authorized by USAID. Reg. 216 establishes a process for the review of environmental and social impacts; and ensures that projects that are undertaken as part of programs funded under USAID are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and as required by the legislation are not likely to cause a significant environmental, health or safety hazard.

The Initial Environmental Examination (IEE) for GMIP was drafted and approved by the Europe and Eurasia Bureau Environmental Officer (BEO) on June 23, 2010 (DCN: 2010-GEO-033). Pursuant to Reg. 216 and the IEE's Positive Determination for Component 2, an Environmental Assessment (EA) is required. This EA was prepared to comply with the Positive Determination and is meant to ensure that environmental consequences and their significance are known and clearly identified prior to the approval of the final design and start of construction [216.3 (a) (4)].

LTD KAV and Tetra Tech led the scoping process for the irrigation rehabilitation EA. The team identified, reviewed, and prioritized environmental issues. An initial public stakeholder scoping meeting was held on July 1, 2011 in Gori. A second public stakeholder meeting, conducted during the EA phase, was held on November 18, 2011 at the Verkhvebi Settlement in Gori Municipality. The Scoping Statement was approved by the USAID/Europe & Eurasia Bureau Environmental Officer (BEO) on November 30, 2011.

1.4 Major Conclusions

The EA Team used the potential significant concerns identified in the Environmental Scoping Statement (ESS) and analyzed them in the EA. Further investigation during the EA allowed the EA Team to

eliminate some potential concerns from further analysis (they were found not to be potentially significant), while others are evaluated in detail in the EA as shown below:

- **Impacts to threatened, endangered and protected species (TES) and disruption to wildlife or sensitive ecological habitats.** TES and habitat are described and mitigation is proposed.

- **Impacts to wetlands, disturbance of ecological habitats and hydraulic and hydrological concerns on habitats.** Important habitats are described and mitigation is proposed.

- **Impacts to cultural resources.** Cultural/historical resources are identified and mitigation is proposed

- **Increased irrigation leading to agricultural intensification, extensification, and/or increased irrigation and inputs of seeds and fertilizer.** This concern is analyzed and mitigation is proposed.

- **Impacts of changes in water quality and sediment loads; degradation of irrigation water quality and deterioration of downstream water.** This concern is analyzed; no additional mitigation is proposed.
-
- **Effects of waterborne pathogens/diseases resulting from increased irrigation water availability and use of polluted wastewater for irrigation.** Further investigation found this concern not to be significant.

- **Discharge water from irrigated fields warmer than receiving waters, encouraging weed growth and harming fish and bird populations.** Further investigation found this concern not to be significant.

- **Cumulative impacts of all irrigation systems within the river system and unplanned expansion of irrigation schemes or unplanned eff*e*cts due to changes in the occupied zone.** This concern is analyzed; no additional mitigation is proposed.

- **Foresee possible conflicts over land and water; disruption of local socio-economic arrangements. Identify potential conflict poin*t*s related to irrigation water provision.** Land and water conflicts are analyzed and mitigation is proposed.

- **F*i*sheries concerns from inadequate exploitation of irrigation channels; sedimentation and constraining fish migration.** This concern is analyzed and mitigation is proposed.

- **Alterations to hydrology and watersheds; water shortages inefficient irrigation methods.** This concern is analyzed and mitigation is proposed.

In addition to these significant effects, the EA Team identified best practices for a range of potential concerns that were noted in the ESS. These concerns were eliminated from further consideration in the EA because they did not require any further assessment; the ESS stated that best practices exist that would mitigate impacts.

The EA Team developed mitigations (including best practices) to address impacts associated with construction activities, channel rehabilitation, disposal of channel spoil and sediment, damaged concrete, road improvements, socio-Economic and public health and safety. Mitigations also address impacts to TES and cultural and historic resources. Mitigations also cover irrigation operation including soil impacts (e.g., water logging and salinization), water impacts, impacts to TES and cultural/historic resources and irrigation O&M system wide management.

EMMPs were developed for construction (Table 6.1) and operation (Table 6.2) of the irrigation schemes. EMMPs include the identified environmental impacts, individual mitigation measures, monitoring indicators, monitoring/reporting frequency and responsible party for oversight of EMMP implementation. EMMPs mitigate the following identified environmental impacts during construction and irrigation channel rehabilitation:

- **Impacts** to Threatened, Endangered & Protected Species (TES) including: Mediterranean tortoise, European marsh turtle, Red List & migratory birds, Geoffroy's bat, common otter and Brandt's hamster and gray dwarf hamster.

- **Impacts** to Threatened, Endangered & Protected Species (TES) fish including: Golden spined loach, brook trout and Kura undermouth. Protect Spawning Areas.

- **An impact to Cultural and Historic Resources including Nikozi Cathedral Ensemble and damage to cultural or historic chance finds**.

- Construction Camp **Damage** to Local Habitats and Depletion of Local Fauna/Flora. Impacts from Lack of Environmentally Sound Facilities or Poor Sanitation at Construction Camp Facilities. Impacts from Lack of Management of Construction Areas, Equipment and Materials Storage.

- Community **Impacts** from Introduction of Alcohol and Other Socially Destructive Substances via Construction Crews.

- **Impacts** from Lack of Control of Storm water runoff during Irrigation Rehabilitation. Impacts from Removal and Disposal of Irrigation Channel Spoil, Sediment, and Bushes/Trees. Impacts from Removal and Disposal of Damaged/Broken Concrete Panels and Slabs.

- **Impacts** from Channel Rehabilitation (Add Compacting Soil to Bottom of Channel or Construct Concrete Slabs/Panels). Impacts from Rehabilitation of Channel Crossings (Construct New Crossings if needed, Allow for Animal Crossing to Grazing Areas). Impacts from Access Road Improvements.

- Noise, Odor and Visual Quality **Impacts**. Socio-economic Impacts. Public Health and Safety Impacts.

EMMPs mitigate the following identified environmental impacts during operation of the irrigation systems:

- **Impacts** to Threatened, Endangered & Protected Species (TES).

- **Impacts** to Cultural and Historic Resources.
- Soil **Impacts** including Waterlogged Soil and Salinization.
- Water **Impacts** including Poor Irrigation Methods, Water Quality and Water Quantity Problems for Downstream Users.
- Socio-economic **Impacts.** Public Health and Safety Impacts.
- Water, Soil and Other Environmental **Impacts** due to Weak Systemwide O&M Management System.

1.5 Areas of Controversy and Issues to be Resolved

The EA Team did not identify any remaining areas of controversy, nor issues that need to be resolved.

2. Underlying Purpose and Need to Which Proposed Action is Responding

2.1 Project Description

The Tiriponi and Saltvisi irrigation schemes in Shida Kartli Region were identified by GoG as priority targets for USAID technical assistance. These systems were impacted by Georgia's 2008 conflict with Russia. Both schemes previously received water from the same head works located on the Didi Liakhvi River at Tskhinvali. The head works is now in the occupied zone and flow to the two schemes was cut-off in 2008. To adjust to this situation GoG constructed the Kvemo Nikozi diversion dam and pumping station on the Didi Liakhvi River, several kilometers downstream of the old head works. The new pump station has six pumps and a seventh will begin operation in 2012. For the GMIP project design, six pumps will serve Tiriponi and one will serve Saltvisi.

Target proposed GMIP irrigation scheme interventions consist of:

- Rehabilitate the complete **Saltvisi Irrigation System**;
- Rehabilitate **Karbi Headworks**; and
- Rehabilitate the main canals of the **Tiriponi Irrigation System** up to its first crossing of occupied territory and critical/significant facilities on the Tiriponi main canal after its first crossing with occupied territories.

The primary source of water for the existing Tiriponi and Saltvisi irrigation systems is from the Kvemo Nikozi diversion dam and pump station located on the Didi Liakhvi River. Tiriponi also receives water from the Patara Liakhvi River via a gravity diversion structure at the existing Karbi Headworks. Saltvisi receives additional water from a gravity intake regulator on the right bank of the Kvemo Nikozi pump station and from a related downstream off-take channel from the Didi Liakhvi River.

Saltvisi: For Saltvisi, activities include cleaning channels of vegetation and sediment; restoring and shaping the channel in earth-lined sections; lining the bed and slopes of the channel in proposed lined sections; repairing and improving the linings of the damaged sections of the lined channels to make them more water-tight and hydraulically efficient; determining and eliminating points of excess canal seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

Karbi Headworks: For Karbi Headworks proposed rehabilitation includes removal of sediment, restoring concrete on the diversion dam and intake, bank protection works, cleaning the riverbed, restoring the flushing galleries, arrangement of a trash-rack for the head works, restoring/repairing the regulating gates, replacing and providing mechanical and electrical systems for lifting of gates, providing on-site housing for the operator, constructing a fish by-pass, and installing flow measurement capability.

Tiriponi: For Tiriponi, activities include cleaning channels of vegetation and sediment to make them hydraulically efficient; repairing and improving the linings of damaged sections of channels to make them water-tight and hydraulically efficient; determining and eliminating points of excess channel seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

2.2 Purpose and Need for the Proposed Action

The purpose of GMIP Component 2, Rehabilitation of Irrigation Infrastructure, is to repair infrastructure that Georgians rely on for jobs, income generation, and for maintaining their agricultural heritage. The GoG irrigation rehabilitation program intends to provide high quality irrigation water to as many farmers as possible. The current state of disrepair renders the irrigation systems extremely inefficient, and in many cases, the irrigation channels are in such poor shape that they fail to bring water to previously agricultural land that could be put back into production. GMIP expects to rehabilitate 8,500 hectares of rural land in the Tiriponi Irrigation System and 9,700 hectares in the Saltvisi System, restoring a total of 18,000 hectares of productive capacity. Thirty-one villages will be provided with irrigation water, 20 in Tiriponi and 11 in Saltvisi. This rehabilitation is also expected to help more than 20,000 small farmer households, 9,790 in Tiriponi and 11,080 in Saltvisi. Of these households, over 10,000 are IDP families.

GMIP will rehabilitate irrigation headworks and main channels (cleaning and improving concrete surfaces, water control valves and structures, and other associated water transportation structures and devices). GMIP channel interventions entail two primary actions: a) cleaning the channels of vegetation and soil deposits to make them more hydraulically efficient, and b) repairing and improving the linings of the damaged sections of the channels to make them more water-tight and improve hydraulic efficiency. In some cases the cross sections of the channels will be designed to more effectively transport the smaller quantities of water now needed by the districts. This will help reduce the amount of water that is currently used and wasted, thus reducing the amount of water that is currently extracted from the rivers as well as reduce the amount of money spent on pumping the water.

GMIP addresses needs resulting from Georgia's August 2008 conflict with Russia and the global economic downturn that has challenged Georgia's economic stability. These needs have placed a severe strain on Georgia's national budget and its ability to finance core investments in critical regional development initiatives like irrigation. Many years of decline in the quality, coverage and maintenance of irrigation systems have dramatically reduced Georgia's quality of life in rural areas and constrained private sector growth. Such degradation and instances of conflict-related damage have resulted in significant constraints to the productive capacity and quality of life of thousands of Georgians.

2.3 Status of Environmental Compliance Documentation

2.3.1 Summary of 22 CFR 216 Requirements and the IEE for GMIP Component 2

USAID's environmental regulations (22 Code of Federal Regulations 216 or Reg. 216) establish the conditions and procedures for environmental review. These procedures apply to new projects, programs, or activities authorized by USAID. Reg. 216 establishes a process for the review of environmental and social impacts; and ensures that projects that are undertaken as part of programs funded under USAID are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and as required by the legislation are not likely to cause a significant environmental, health or safety hazard.

The IEE for GMIP was drafted and approved by the Europe and Eurasia Bureau Environmental Officer (BEO) on June 23, 2010 (DCN: 2010-GEO-033). Pursuant to Reg. 216 and the IEE's Positive Determination for Component 2, an Environmental Assessment (EA) is required. This EA was prepared to comply with the Positive Determination and is meant to ensure that environmental consequences and their

significance are known and clearly identified prior to the approval of the final design and start of construction [216.3 (a) (4)].

2.3.2 SSECP

During an initial environmental review phase, GMIP prepared a Site Specific Environmental Compliance Plan (SSECP). In the SSECP, GMIP described the Tiriponi Irrigation Scheme as a small-scale activity resulting in rehabilitation of primary and secondary canals to reduce water losses. The SSECP provided an evaluation of the rehabilitation of existing canals, which involved removing sediments and bushes from the old canals, and replacing old deteriorated concrete linings. The SSECP stated that since the irrigation volumes would be less than volumes in the original irrigation system, environmental impacts would be reduced from the original system. Also, since GoG had already built the needed irrigation pumping stations and GMIP would be collaborating with other USAID projects (EPI and NEO) to improve productivity at the farm-level, impacts would be reduced even further. Overall, GMIP expected irrigation system leakage to be reduced from more than 60 % to less than 20%.

GMIP used the SSECP to support a 22CFR216 Negative Determination with the condition that detailed EMMPs be implemented to cover irrigation canal rehabilitation design, implementation and cleanup operations. The BEO evaluated this request and determined the GMIP irrigation activities were not small scale, that the scoping process needed more involvement of stakeholders, more baseline data and information collection and better comparison of environmental impacts and alternatives. The BEO also recommended additional assessment of cultural and historic resources, and biological resources, including wildlife habitats. This EA is responding to these BEO comments on the SSECP.

2.3.3 Environmental Scoping Statement

The Scoping Team consisted of LTD KAV and Tetra Tech. The team identified, reviewed, and prioritized environmental issues. This was accomplished through the following three tasks:

- Identifying and reviewing existing environmental information and studies related to GMIP-Component 2;
- Carrying out site visit investigations to ascertain any additional environmental issues; and
- Obtaining stakeholder input in organized meetings to ensure that significant environmental and social issues for inclusion in the EA were identified.

An initial public stakeholder scoping meeting was held on July 1, 2011 in Gori. The purpose of the meeting was to provide information and get the views on the proposed project from citizens. Twenty-nine participants attended the meeting. A second public stakeholder meeting was conducted during the EA phase. The meeting was held on November 18, 2011 at the Verkhvebi Settlement in Gori Municipality. Thirty-two participants attended. The focus of this meeting was to obtain the opinions of those who did not participate in the first meeting. Minutes of the meeting are attached in Appendix 8.1.

The public meeting provided a forum for discussions on several specific issues. The facilitator invited participants to give their feedback on the following discussion issues (Appendix 8.1 minutes provide the feedback of stakeholders.):

- How will equitable access to irrigated lands be addressed? Equitably shared benefits from production? Will there be adequate access to markets? Will farmers have enough demand for their production?
- What impact will the rehabilitation have on wetlands and downstream ecosystems?
- What are current land tenure arrangements?
- Are there differences in men's and women's roles and relationships that may affect the long-term future of the scheme and the environment?
- What is happening to the quality of the soil in the area? What exist and future soil maintenance needs (e.g., will soil fertility decrease due to intensive cropping and nutrient leaching)? What changes have farmers observed in the last 30 years?
- What is the potential for soil salinization or other long-term, cumulative effects?
- Are there any current pest problems?
- What is the condition of the potable water supply? Are there potential health issues?
- What is the current incidence of water-borne diseases?
- Are there any important cultural or archaeological heritage issues along the irrigation network or in the area?
- What are the fishery resources in canals and in rivers?
- Any migrating and/or game bird species in the area, birds of prey?
- What are the long-term prospects for maintaining canal and irrigation structures? Who will maintain them? How? Who will pay for maintenance?
- What realistically may happen when the project ends? What will the project area look like in 30 years?

The attached minutes also state the questions and the answers provided by the Scoping Team during the meeting, and include the meeting announcement, agenda, photos, names of the participants and the GMIP presentation. The EA team believes that the public meetings, site visits, document reviews, and other meetings with government and environmental specialists have identified all of the potentially significant environmental and social issues for evaluation in the EA.

2.3.4 Stakeholder Engagement and Host Government Consultation

GMIP was designed in close coordination with the GoG. GMIP's local partner is the GoG's MDF. As part of feasibility studies, GMIP staff visited all irrigation project sites, and has met with stakeholders. In addition to meeting with stakeholders during the scoping process, GMIP has collaborated with stakeholders as part of the design process to ensure the design is socially and culturally acceptable. GMIP will continue to hold regular consultations through design and construction activities and up to hand over to the GoG.

2.3.5 Host Country Environmental Context

The projects covered by this EA, rehabilitation of irrigation schemes, do not require an Environmental Impact Permit (EIP) or State Ecological Examination under Georgian legislation. Local permits are required, as shown in the table below:

Table 2-1: Local Permits Required for Irrigation Rehabilitation

Permit Type	Comments
Building/Construction	Local permits required
Source Material Extraction	
Waste Disposal	
Wastewater Discharge	
Air	
Water Use	
Historical or Cultural Preservation	
Wetlands or Waterbodies	Water law and riverbank protection may be applicable
Threatened or Endangered Species	Unlikely
Other	

3. Alternatives Including the Proposed Action

This chapter provides a discussion of the "Project Alternatives" followed by a comparison of the alternatives based on potential significant environmental impacts. The EA Team began with the alternatives developed by the Scoping Team; no additional feasible alternatives were identified during the EA preparation process. The EA Team eliminated two alternatives included in the Environmental Scoping Statement (ESS) because they were clearly unreasonable because of GoG decisions already made. Pumping stations delivering river waters to irrigation networks have already been built and open channel irrigation systems already exist. (See Section 3.2)

The feasible alternatives considered further in the EA are: the Proposed Action (Alternative 1); the Proposed Action Plus Water User Associations/Privatization (Alternative 2); and No Action (Alternative 3).

3.1 Description of Project Alternatives

This section describes three alternatives that meet the project's purpose and need to improve the Tiriponi and Saltvisi irrigation network. The Agency's preferred alternative is Alternative 2 (the Proposed Action). Alternative 3 is included to help evaluate the comparative merits of the alternatives.

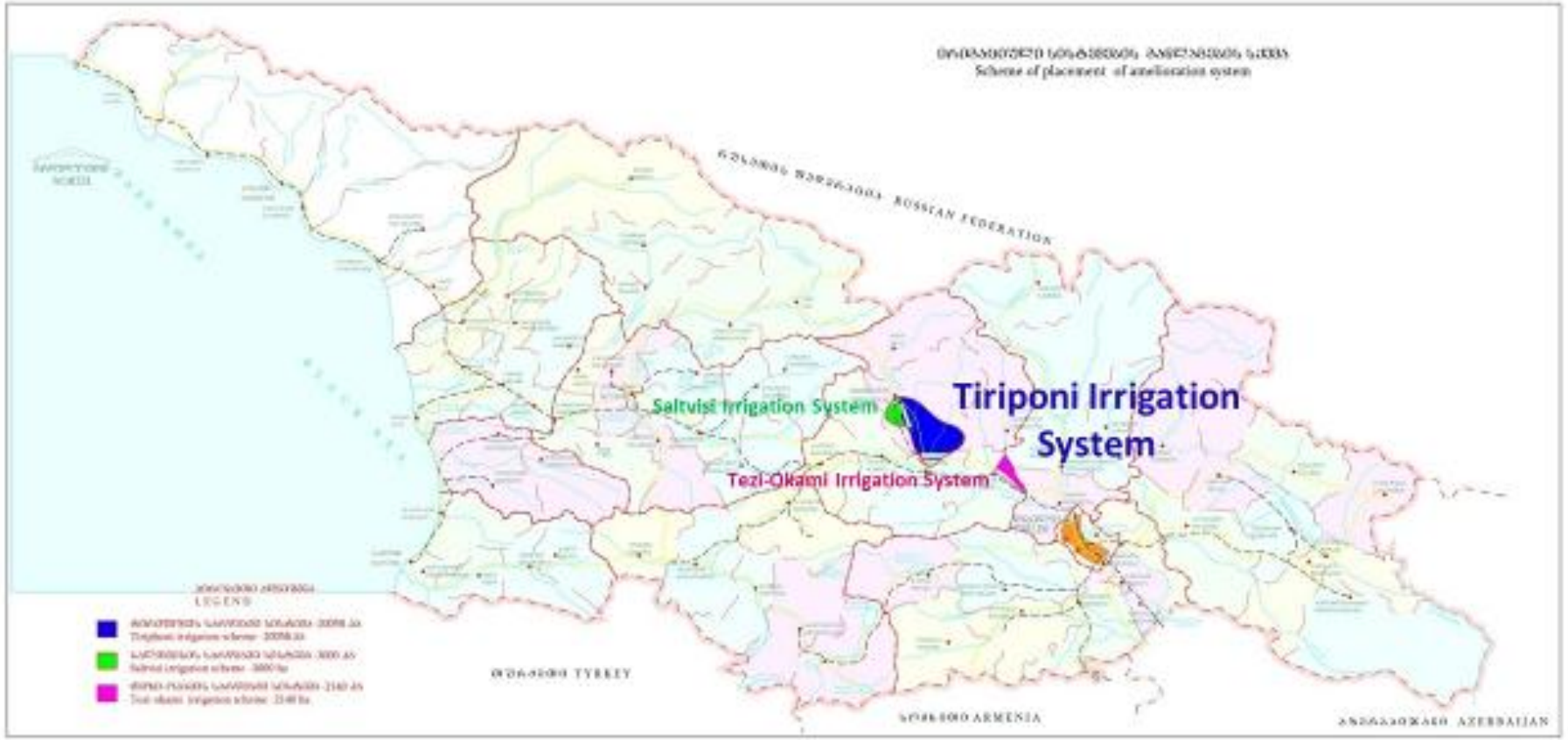
3.1.1 Alternative 1 – Proposed Action

The Tiriponi and Saltvisi areas are shown on three project maps (Figure 3.1). The Proposed Action (Alternative 1) includes working directly with Mtkvari-M Ltd, the company in charge of the operation and maintenance of the irrigation schemes and the main beneficiary of this GMIP Component 2.

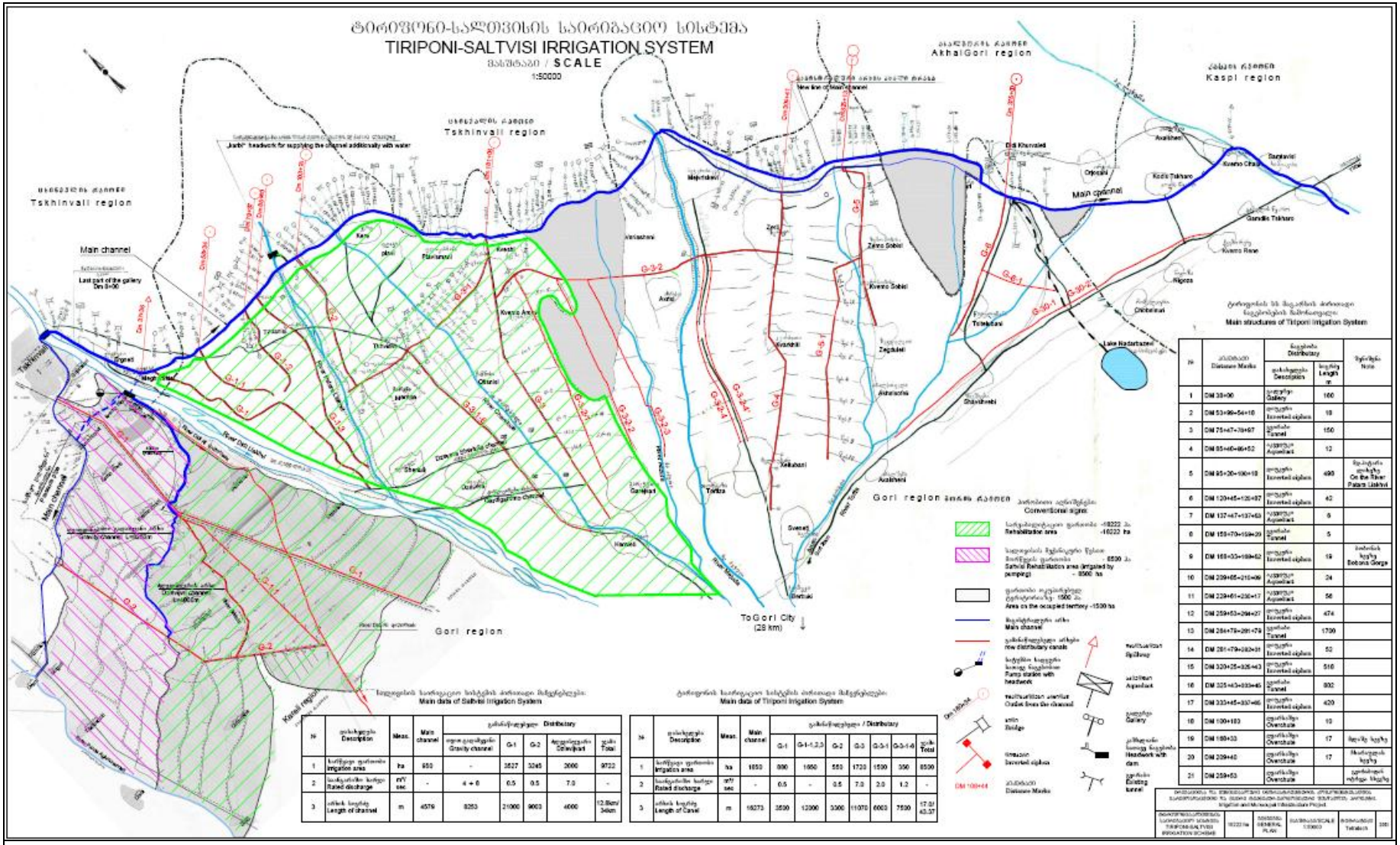
GMIP will coordinate with the USAID Economic Growth (EG) Office's Economic Prosperity Initiative (EPI) and New Economic Opportunities (NEO) projects. The structure envisioned is that GMIP will provide the financing and engineering for infrastructure rehabilitation and EPI and NEO will focus on technical assistance and training to help farmers use irrigation schemes efficiently and effectively. GMIP will also seek to collaborate with the Energy and Environment (E&E) Office's Integrated Natural Resources Management in Watersheds of Georgia (INRMW).

GMIP will provide assistance to Mtkvari-M to increase its capacity to help local farmers use water efficiently and effectively. Mtkvari-M will assist farmers to use improved irrigation methods including drip irrigation and sprinkler methods. Different irrigation methods will be appropriate for different crops and farming systems, and Mtkvari-M is best placed to provide this assistance to target farmers. Drip irrigation, sprinkler methods, and rain-fed crop production (all including rainwater harvesting) typically use smaller amounts of irrigation water and shorter application times compared to the current method, which is mainly flood irrigation. Mtkvari-M staff will be trained in measures for efficient sprinkler irrigation, including application schedules, optimum water pressures, use of new, efficient sprinkler heads, and selection of crops appropriate for sprinkler irrigation.

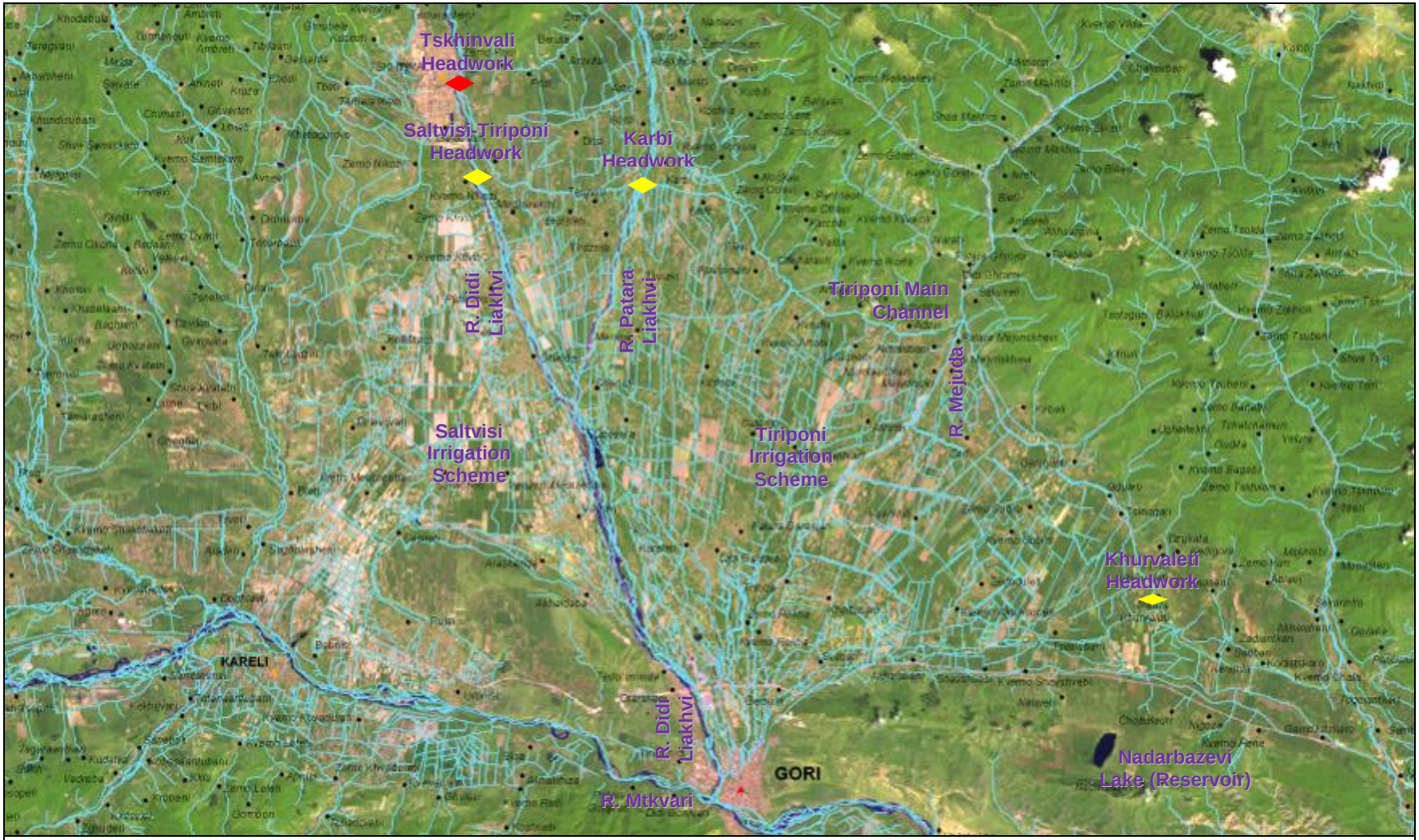
Figure 3.1: Project Maps



Map 1. Location of Tiriponi Irrigation Scheme (source: Kavgiprotransi-MG Ltd Feasibility Study July 2011)



Map 2. Tiriponi and Saltvisi irrigation schemes



Map 3. Satellite image of Tiriponi and Saltvisi Valleys (source: Landsat 5 TM, June, 2011)

Gori

GMIP will also assist Mtkvari-M to strengthen its capacity in life-cycle cost considerations, agricultural product quality improvements, and methods for collecting rain to supplement river/stream irrigation water. Farmers will be encouraged to plant crops that are well-adapted to the water environment of the Tiriponi-Saltvisi zones.

The primary source of water for the Tiriponi irrigation system is the Kvemo Nikozi pump station on the Didi Liakhvi River. A second source of irrigation water is the Patara Liakhvi River gravity flow diversion structure at the existing Karbi Headworks. There are various other small rivers (Patara Liakhvi, Akura, Mejuda, Tortla, Lagomakhevi, Bersheula, and Charebula) that cross through the area that are used by local farmers for irrigation.

The Tiriponi rehabilitation is divided into three phases. The USAID project will rehabilitate the first phase which includes Karbi Headworks, the main canal from Karbi to the point at which main canal crosses into occupied territory and several canal structures (one gallery, 2 tunnels, 3 aqueduct, and 4 siphons). The Tiriponi rehabilitation includes about 60 km of irrigation channels (G-1, G-1-1, G-1-2, G-1-3, G-2, G-3, G-3-1 and G-3-1-6) that will provide irrigation water to 8,500 ha. The channels included in the Tiriponi rehabilitation are shown in Figure 3.1, Map 2 (above the Didi Liakhvi River, channels in red).

Karbi Headworks: For Karbi Headworks proposed rehabilitation includes removal of sediment, restoring concrete on the diversion dam and intake, bank protection works, cleaning the riverbed, restoring the flushing galleries, arrangement of a trash-rack for the head works, restoring/repairing the regulating gates, replacing and providing mechanical and electrical systems for lifting of gates, providing on-site housing for the operator, constructing a fish by-pass, and installing flow measurement capability.

Tiriponi: For Tiriponi, activities include cleaning channels of vegetation and sediment to make them hydraulically efficient; repairing and improving the linings of damaged sections of channels to make them water-tight and hydraulically efficient; determining and eliminating points of excess channel seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

The Saltvisi system receives water from the Kvemo Nikemo diversion dam on the Didi Liakhvi River via two sources: a) from the Tiriponi pump station located on the left bank and b) through a gravity intake regulator on the right bank. Water from the Tiriponi station is pumped 3 km through a new pipeline. The Nikozi gravity off-take on the right bank and a second downstream off-take channel convey water into the Dzlevisjvari channel. The GMIP rehabilitation includes about 45 km of irrigation channels ((G-1, G-1-1, G-2 and the former Dzlevisjvari channel) that will provide irrigation water to 9,700 ha. The channels included in the Saltvisi rehabilitation are shown in Figure 3.1, Map 2 (below the Didi Liakhvi River, channels in red).

Saltvisi: For Saltvisi, activities include cleaning channels of vegetation and sediment; restoring and shaping the channel in earth-lined sections; lining the bed and slopes of the channel in proposed lined sections; repairing and improving the linings of the damaged sections of the lined channels to make them more water-tight and hydraulically efficient; determining and eliminating

points of excess canal seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing/graveling access roads.

Repair and rehabilitation interventions for the Tiriponi and Saltvisi irrigation channel networks will include the following:

- Sediment should be removed from the main channel using excavator/dragline; sediment under bridges will be cleared manually.
- Spoil from the channels will be partially displaced to on-site storage or offsite disposal;
- Existing trees and bushes growing within the channel will be removed from the channel, collected, replanted (if possible) or properly disposed of. Cut trees will be stored for reuse or burning (for heat or energy);
- Inspection/service roads will be improved to allow better access for proper O&M;
- The rehabilitation will make maximum use of the existing lining and structures in the rehabilitation process;
- Damaged or broken reinforced concrete slabs/panels (6 x 1.5 x 0.1 m) will be removed from the sides of the canal and replaced with new panels;
- Concrete slabs/panels that are intact but have slid into the channel should be lifted and put back in place;
- All replacement and new panels will be placed on a 10 cm gravel bed;
- Proper joints will be provided between the concrete slabs/panels;
- At turnout structures single-sided bottom gates with side outlet pipes and flow metering will be installed.

Rehabilitating irrigation channels also includes repairing and graveling access roads. Access roads are located along most of the irrigation channels, except where the channel is located next to a public road. These roads were needed for construction as well as for operation and maintenance of the irrigation systems. Access roads were part of the original Tiriponi and Saltvisi systems dating back to soviet times. They are now in poor condition, sometimes only ruts in the grass. As part of the irrigation channel rehabilitation, access roads will be repaired, eroded areas fixed, realignment where needed, and a gravel surface added.

Alternative 1 includes a system-wide O&M management process that involves use of better irrigation water measurement systems to promote more efficient use of water in the Tiriponi and Saltvisi irrigation zones. The present practice estimates the amount of irrigation water delivered over time. Better water delivery monitoring systems will be promoted through system-wide irrigation data collection and feedback assessment. New systems will take into account that water resources are limited in these zones and that measuring devices were never installed at the lower system level and that there are administrative costs of policing, measuring, recording, and collecting the water data. Assistance will be provided with methods of conflict resolution associated with land and water rights. The O&M management system will provide improved primary and secondary channel operations, better water schedules, and will identify needs for preventive maintenance and early identification of water and soil problems including salinity.

The project does not envisage works outside the borders of the irrigation network. All the construction works are planned within the existing alignment of the main and distribution canal network. No new channels will be constructed. The agricultural fields that will be using the irrigation water are also already established now for many years – the channels will feed no newly irrigated lands.

3.1.2 Alternative 2 – Proposed Action Plus Water User Associations/Privatization

This alternative includes all the measures in Alternative 1 plus development of Water User Associations to operate the irrigation and drainage system. The alternative requires rehabilitation and repair of irrigation infrastructure and GoG would sell or transfer ownership to new owners (interested farmers or farmer groups organized as Water User Associations). The alternative includes privatization or semi-privatization through a public authority or holding company.

This alternative was discussed with GoG and the GMIP Steering Committee during the EA preparation phase. They thought the previous Georgian experience with Water User Associations is important today. The World Bank Irrigation and Drainage Community Development Project (Tacis) focused their 2001 program on Water User Associations. Mid-way through the project, GoG eliminated these associations and the resulting program effectiveness of Tacis was severely affected. They do not think these associations will work in Georgia. Even if they were started again, they do not think the GoG would fund them in the future. GoG reorganizations and changes in public awareness of water as a public good could easily result in government take-over of the association, especially during droughts or other food security crisis. The associations would likely be terminated during the first crisis or opportunity.

3.1.3 Alternative 3 – No Action Alternative

The No Action Alternative means that USAID will not support the project and therefore, irrigation channels and infrastructure would not be rehabilitated. Without this project, the two irrigation schemes would not meet GoG expectations that they will be able to irrigate up to 18,000 hectares of land that could be restored to productive capacity, or be made significantly more productive for up to 10,000 small holders; thus, the schemes would not contribute to improved livelihoods through new or greatly enhanced agriculture productive capacity. IDPs affected by the 2008 conflict with Russia and other rural populations would not benefit from the improved irrigation network.

Under the No Action Alternative, irrigation would remain inaccessible to many agricultural fields, and sustainable agriculture and economic growth in rural Georgia would be reduced. Given the reliance on family-based agriculture and the income it generates, food security could become a concern. This alternative provides a benchmark against which the action alternatives may be evaluated.

Local farmers with already limited economic opportunities would be hurt more severely. Agricultural incomes would continue to be low and pressure would increase on farmers to leave rural Georgia and farming, placing added pressures on urban areas where employment opportunities are stressed.

Much of the agricultural land will be abandoned, and eventually the area may return to brush-shrub vegetation. This may provide habitat for some wildlife. Irrigation infrastructure would continue to deteriorate, and may disrupt flows, resulting in more flooding of land adjacent to the canals. Erosion will continue, and some channels may become filled with silt. Thus, areas upstream may be more prone to flooding. The deteriorating irrigation infrastructure could present a safety hazard to humans and livestock. Slopes will become less stable, and when crossed could collapse. Water wastage would remain an issue since the current channels are in very poor condition. There are many leaks and significant water losses.

3.2 Alternatives Eliminated from Analysis and Rationale for Eliminating Alternatives

The EA Team eliminated two alternatives that were proposed during the scoping process: Groundwater Irrigation Alternative and Closed Pipe Irrigation Alternative. After further consideration during the EA phase, both of these alternatives were determined to be unreasonable. The focus of the GoG irrigation program is to provide high quality irrigation water to as many farmers as possible. These rehabilitated systems are intended to improve agricultural product quality and quantity and increase farm income, economic growth and rural quality of life. Neither of these alternatives would provide irrigation to the number of farmers envisioned under the GoG initiative, and even though significant financial investment would be involved, neither would produce the high impact that the GoG envisions and that Georgia needs since far fewer hectares could be irrigated and far fewer farmers would benefit. More information is provided below on each alternative.

Groundwater Irrigation Alternative: The Groundwater Irrigation Alternative considered both total use of groundwater as the source of irrigation waters and partial use of groundwater (including part of the Proposed Project Alternative 2 plus new irrigation waters for farmers located at tail-ender locations away from secondary channels). This partial use of groundwater includes complete rehabilitation of the Saltvisi irrigation system and rehabilitation of the main canal and secondary canals of the Tiriponi irrigation system up to its first crossing of occupied territory. The part of Alternative 1 involving rehabilitation of critical/significant facilities on the Tiriponi main canal after its first crossing with occupied territories would be replaced with drilling of new groundwater wells and multi-farmer irrigation delivery systems.

Groundwater has been used for irrigation previously in Georgia, but all wells were rather deep and equipped with turbine pumps which were expensive to construct and operate. Most have been abandoned. The World Bank Irrigation and Drainage Community Development Project EIA estimated that providing small pumps to individual farmers would cost about $10,000 (for a typical well of 60 m depth and a small turbine pump providing 2 - 4 liter/sec. The system requires electricity, storage reservoirs and a small pipe distribution system.

The groundwater alternative has several technical difficulties: (a) deep aquifers with uncertain potential water yields; (b) complicated hydro-geographical assessments; (c) need for additional on-farm infrastructure; and (d) need for reliable electric power source. At the November 18 stakeholder public meeting, there was discussion about groundwater irrigation and participants mentioned that it was not considered viable in the Tiriponi and Saltvisi irrigation areas because

with the higher elevation of these schemes, the groundwater levels exceeded 100 m depth. These difficulties along with the requirement for high level technical knowledge and skills to maintain the groundwater fed irrigation scheme contributed to the GoG decision to build irrigation systems dependent on river waters. New pumping stations delivering river waters to irrigation networks have already been built, pumps installed and much of the water is already in the irrigation networks.

Closed Pipe Irrigation Alternative: This alternative would have replaced open channels with closed pipelines in the irrigation canals described in the proposed action (Alternative 1). This would include the complete rehabilitation of the Saltvisi irrigation system, rehabilitation of the main canal and secondary canals of the Tiriponi irrigation system up to its first crossing of occupied territory and rehabilitation of critical/significant facilities on the Tiriponi main canal after its first crossing with occupied territories.

The closed pipeline system would cover many thousand hectares. Replacing open channels with pipelines would reduce water losses from channel leaks and evaporation, and reduce possible contamination. However, GoG has not considered the losses or possible contamination to be significant issues in Georgia. The mountain-like, moderately wet subtropical climate in the Tiriponi and Saltvisi region does not severely increase evaporation losses and their physical location does not lead to increased opportunity for contamination. .

3.3 Comparison of Environmental Impacts of Program Alternatives

As required by 22 CFR 216.6(c) (3), Table 3.1 shows, in comparative form, impacts of the proposed GMIP and its feasible alternatives. As stated in USAID's Environmental Procedures, this section is meant to sharpen the issues, illustrate the comparative merits of each alternative, and provide a clear basis for choice among the options. Section 5, Environmental Consequences, provides the analytic basis of the alternatives comparison.

Potential environmental issues (Table 3.1, column 1) are from the Scoping Statement. In Table 3.1, the alternatives consider both the construction stage and operation stage of the irrigation alternatives.

Table 3.1 Comparison of Alternatives

(+2) highly positive effect/beneficial; (+1) positive/beneficial; (-2) significant negative effect/highly detrimental; (-1) negative effect/detrimental; (0) remains the same (i.e., no effect or same rate of change versus gets progressively worse or better)

Potential environmental issues (identified in the Scoping Statement)	Alternative 1: Proposed Action		Alternative 2: Proposed Action Plus Water User Associations/Privatization		Alternative 3: No Action
	Construction	Operation	Construction	Operation	
1) Rehabilitation, including construction and operation phases, could impact TES and their habitat and could also affect other species of concern. This could occur through direct impacts (workers may over-fish or hunt	-1	-1	-1	-2	0

without oversight) or it may occur indirectly through habitat alterations due to irrigation and agricultural production. Short and long -term impacts are possible.					
2) Rehabilitation, including construction and operation phases, could impact wetlands and other habitats. There may be direct and indirect impacts (withdrawing water may reduce and dry up riparian habitat –direct; and irrigation may encourage conversion of natural areas to agriculture-indirect). Short and long-term impacts are possible.	-1	-1	-1	-1	+1
3) During the construction phase, cultural resources may be found, disturbed, and/or destroyed.	-1	0	-1	0	-2
4) With increased water available, agricultural production may expand into areas of ecological importance and result in conversion and fragmentation of habitat during the operation phase of this project. Impacts are likely to become apparent over the long-term during the operation phase.	0	-1	0	-1	0
5) Irrigation water may carry contaminants downstream to areas where they may concentrate (if flushing is in adequate) and/or to areas where they may cause significant damage to land, crops, and other natural resources, and if they enter groundwater or surface water points, may threaten drinking water quality. This is mainly a long-term impact that is of concern during the operation phase.	0	-1	0	-1	-1
6) Irrigation water can carry waterborne diseases that could affect humans, livestock, and crops. This is a concern during the operation phase, and may be a short (problems may arise immediately) and long-term impact (health problems may arise any time over the operation phase).	0	0	0	0	-1
7) Discharge water from irrigated fields may be warmer than receiving water and could affect fish and bird populations. This is a concern during the operation	0	0	0	0	0

phase and may be a short or long-term impact.					
8) Cumulative impacts may result from the combination of past, present, proposed, and reasonably foreseeable actions. A cumulative effects analysis is part of all EAs.	-1	0	-1	-2	0
9) Rehabilitation of irrigation schemes may fuel land and water conflicts and may make other underlying socio-economic issues more apparent. This is a concern during the operation phase and a potential long-term impact.	0	-1	0	-2	-1
10) Water withdrawals for irrigation and sedimentation from operation of the irrigation scheme may affect fish migrations.	0	-1	0	-2	-1
11) Irrigation may result in unsustainable water withdrawal that results in alterations to watershed hydrology. This impact is long-term and a concern during operation.	0	-1	0	-2	-2

3.4 Discussion of Alternatives with Respect to Significance of Environmental Impacts

Alternatives 1 and 2 have equal impacts during the construction phase. However, during operation (and maintenance) phase, Alternative 1 performs better relative to environmental concerns because Mtkvari-M is expected to be an impartial and well-trained management entity. The Water User Association, while putting oversight and management into the hands of local people—which would be a benefit for local governance and capacity building—would be less beneficial to the environment. As compared to Mtkvari-M, the WUA would have less capacity to manage the system and may not be impartial when allotting water, including for ecosystem purposes. Under the No Action Alternative the land would likely return to brush, and may provide wildlife habitat, but water loss from the deteriorated irrigation system would continue and any demands on water (if there is a drought) would not be able to be mitigated. In addition, cultural resources would continue to be damaged and conflicts over water would not be resolved.

4 AFFECTED ENVIRONMENT

This chapter provides a general description of the human and natural environment of the GMIP irrigation area. It describes, in general terms, the current conditions, including socio-economic, cultural, land uses, soils, geology, biodiversity, climate, air, and water. The Tiriponi and Saltvisi areas are shown on three project maps (Figure 3.1).

As stated in 22 CFR 216, the "affected environment" should be succinctly described and the focus should be on the areas "to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives." In line with this, the baseline description of the affected environment sets the benchmark for the evaluation of the impacts of the program and its alternatives in Chapter 5.

4.1 Population Characteristics

Some of the Information provided in this section is based on the report *Analysis of Socio-Economic Conditions and Development Plan for Gori Municipality*, prepared by the Association of Young Georgian Economists (see http://www.economists.ge/photos_publ/05_11/94.pdf) with support and in cooperation from Oxfam and Welfare Foundation.

4.1.1 Population

The population of Gori Municipality (entire district) as of January 1, 2010 was 143,100 (see Table 4.1), including 51,200 living in Gori (town) and 91,900 living in rural areas. The share of the urban/rural population is therefore 35.5/64.5. Average density of population is 62 persons per sq. km.

Table 4.1: Population of Georgia and Shida Kartli Region

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gori Municipality	154.4	151.5	148.7	146.9	146.4	146.9	135.9	135.8	135.6	135.8	143.1
Shida Kartli	317.0	316.0	314.0	310.5	308.9	309.1	314.0	313.6	312.8	313.0	310.6
Georgia	4,435.2	4,401.4	4,371.5	4,342.6	4,315.2	4,321.5	4,401.3	4,394.7	4,382.1	4,385.4	4,436.4

The population of Gori Municipality is distributed among 21 Territorial Units (see Table 4.2), which include 96 villages. The largest territorial unit is the Town of Gori.

As for the project influence area (also known as the affected environment, project area, and impact area), there are more than 30 villages in the Tiriponi and Saltvisi irrigation zones, all with poorly developed rural infrastructure. There are schools in larger villages.

Table 4.2: Population of Gori Municipality's territorial units and villages (as of 1 January 2010)

#	Territorial Unit	Village	Population
1	Kvakhvreli	Kvakhvreli	2371
		Uplistsikhe	728
		Velebi	25
2	Ateni	Ateni	3069
		Tsedisi	283
		Bravisi	281
		Olozi	137
		Ghvarebi	38
3	Tiniskhidi	Tiniskhidi	1907
		Ortasheni	514
		Tedotsminda	732
4	Shindisi	Shindisi	3480
		Pkhvenisi	1280
		Kelktseuli	1000
		Kvemo Khviti	1200
5	Variani	Variani	1680
		Akhaldaba	1770
		Sakasheti	1120
		Devnilebi	400
		Arashenda	770
		Varianis Murneoba	400
6	Dzevera	Dzevera	1300
		Kitsnisi	1900
		Satemo	560
		Shertuli	360
7	Tkviavi	Tkviavi	2700
		Plavi	1600
		Plavismani	200
		Marana	700
8	Akhalubani	Akhalubani	540
		Kveshi	1396
		Akhrisi	780
		Adzvi	326
		Mumlaantkari	200
		Jariasheni	345
		Tsitsagiantkari	269
		Kvemo Artsevi	635
9	Ditsi	Ditsi	1350
		Kordi	910
		Arbo	325
10	Shavshvebi	Kvemo Shavshvebi	227
		Shavshvebi	300
		Natsreti	594
		Tsitelubani	724
		Nadarbazevi	310
		Khurvaleti	691
		Devnilebi	430
11	Tiordznisi	Tiordznisi	2320
		Megvrekisi	868
		Ergneti	784
		Tergvisi	221
		Brotsleti	847
12	Skra	Skra	1137
		Devnilebi	297
		Akhalkhiza	407
		Rieti	398
		Didi Garejvari	83
		Patara Garejvari	82
		Koshkebi	185
13	Bushuri	Zemo Boshuri	160
		Kvemo Bushuri	176
		Biisi	53
		Bobnevi	191
		Tusrevi	54
		Kvelaantubani	57
		Levitana	233
		Ormotsi	60
14	Mereti	Mereti	1470
		Karbi	810
		Kere	790
		Koshka	260
		Gugutiantkari	180
		Zardiaantkari	138
15	Karaleti	Karaleti	4118
		Devnilebi	1617
		Didi Garejvari	895
		Patara Garejvari	1789
		Satburis Dasakhleba	95
16	Mejvriskhevi	Mejvriskhevi	3936
		Zerti	2682
		Kvarkheti	475
		Pabrikis Dasakhleba	357
17	Nikozi	Kvemo Nikozi	635
		Zemo Nikozi	920
		Zemo Khviti	865
18	Khidistavi	Khidistavi	3890
19	Zeghduleti	Zeghduleti	1070
		Bershueit	1180
		Kirbali	1180
		Zemo Sobisi	560
		Kvemo Sobisi	665
		Kvemo Akhalsofeli	850
		Akhalsheni	150
20	Berbuki	Berbuki	984
		Devnilebi	450
		Rekha	1058
		Sveneti	1578
		Tortiza	1136
		Kheltubani	3549
21	Gori (town)	Gori (town)	51200

(Source: Passport of Gori Municipality)

4.1.2 Economy

Economic sectors of Gori Municipality are as follows: agriculture (20.2%), processing (4.8%), industry (14.8%), construction (5.6%), trade (12.1%), transport and communications (12.4%), public/governance (16.6%), education (5.0%), health (2.7%), and other services (5.8%). GDP of Gori municipality is 1.68% of the GDP of Georgia, a small fraction of the national GDP; the annual per capita income is 2080 GEL.

Key agricultural products in the municipality are grain, canned products, apple concentrates, alcoholic beverages, spirits, and other agricultural products (fruit, vegetables). There are 26 enterprises registered in the municipality, employing over 800 persons. Total production value generated by these enterprises is approximately 41.6 million GEL. Some of these companies work only on a seasonal basis. The main constraints of these enterprises are outdated equipment and lack of investment capital.

4.1.3 Agriculture

The Municipality is a key area for fruit production. By 1990, orchards comprised about 18,000 hectares, with 140,000 to 150,000 tons of fruit produced annually, and with 50% of the district's income derived from this sector.

After land reform, the conversion of orchards to other land uses proliferated and today, the total area of orchards has been reduced to 10,000 hectares. Other factors contributing to this decline are the deterioration of irrigation infrastructure, mostly due to poor maintenance and intermittent supply of water from head works located in the conflict area (Tskhinvali), which supplied the Tiriponi and Saltvisi irrigation schemes. This gradually resulted in reducing extension services, closure of processing facilities, and ultimately, the loss of traditional markets.

Distribution and marketing remains problematic, as the local market is unable to absorb the products. Outdated and non-functioning production equipment at processing plants, deteriorating irrigation infrastructure, and lack of plant protection and agrochemical services are constraints to expanding and modernizing the sector.

Cereals are one of the priority agricultural sub-sectors for the municipality. In recent years, the number of hectares of arable land and agricultural productivity has decreased, with production now at 1.8 to 2.0 instead of 2.8 to 3.0 tons per hectare in the past. The decline is due mostly to poor quality seeds and declining soil productivity, mainly because of the almost complete lack of availability of phosphorous and potassium fertilizers.

Gori Municipality was famous for its unique varieties of grapes (Chinuri, Green of Gori, and Tavkveri) and its vineyards. Until the 1990s, there were 900 hectares of vineyards that produced up to 4,000 tons of grapes. Currently, grapes are cultivated on only 200 hectares, despite micro-zones of 500 hectares that are available in Khidistavi, Ateni, Kvakhvreli, Bravisi, Mejvriskhevi, Kveshi, Plavi and Akhalubani that could produce 3,000 tons annually of Champaign, Chinebuli and Green of Gori grapes. Lack of investment is the main constraint to increasing grape production.

Animal husbandry is also a priority agricultural sub-sector for the municipality, with particular interest in cattle breeding. Until the 1990s, cooperatives of Gori Rayon housed 20-22,000 cattle and 7,000 cattle were in private ownership. Now, only private holders are engaged in husbandry, and there are 30,000 cows, including 19,000 beef cattle and 11,000 milk cows that produce 28,500 tons of milk. The majority—20,000 tons—is sold in local markets, and the remainder, 8,500 tons of milk is consumed by households with milk cows. Marketing of these milk products is limited because there are no milk processing plants in the district. Investment also constrains growth of this sub-sector.

Due to the conflict situation and loss of irrigation capacity, fruit and vegetable production has declined significantly. As of January 2010, agricultural and arable areas were estimated as follows: arable – 21,400 hectares; perennials – 18,200 hectares; mowing – 2,500 hectares; and grazing – 22,300 hectares. There were no large scale agricultural facilities and only two agricultural extension service centers operating in the Municipality.

4.1.4 Public Health

The public health system in Georgia is centralized. Ambulances and hospitals are concentrated in large cities, and small outpatient clinics are available in most villages. The GoG is currently focusing on developing improved health care facilities in all regions. In Gori Municipality, residents are served by hospitals, clinics and ambulance and emergency services. There are private health facilities as well as a military hospital. Almost all community centers have basic ambulance services.

4.1.5 Historical and Cultural Heritage

There are numerous monuments of cultural and historic heritage in Gori Municipality. There are many stone-built castles, towers, churches and settlement ruins. Of particular importance (see photographs below) are the ancient rock-hewn towns of Uplistsikhe, Goris Tsikhe Castle, Gorijvari, Erekles Baths, among others. In accordance with the Ministry of Culture and Monuments of Georgia, there are 136 registered monuments of cultural heritage in Gori Municipality, including 53 located in the city of Gori. Most of these heritage assets are churches and monasteries that are owned by the Patriarchy of Georgia in accordance with the Constitutional Concordat between the Georgian Orthodox Church and the State. There are also many privately-owned dwelling houses that have been awarded the formal status of a monument of cultural heritage. All other monuments are owned by the State.

Zemo Nikozi Cathedral

Uplistsikhe

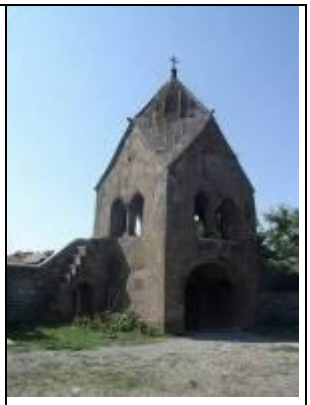
Ateni Sioni Church

Goris Tsikhe Castle

In addition to Zemo Nikozi Cathedral shown above, at least the following sites and monuments of cultural heritage are within the Tiriponi and Saltvisi project area:

1. Village Zemo Nikozi, Church of "Ghvtaeba" - 5th to 6th century
   (Monastery ensemble includes Bell-Tower & Bishop's Palace)
2. Village Zemo Nikozi, Church of Archangel - 10th century (part of the monastery ensemble)
3. Village Bevera, Church of St. George – 9th to 10th century
4. Village Lamiskana, David Orbeliani Palace and home-museum
5. Village Tirdznisi, Church of Trinity (late medieval)
6. Village Tirdznisi, Church of "Dedaghvtisa" 1872
7. Village Tirdznisi, Church of "Kvitartskhoveli" 1886
8. Village Arbo, Church of St. George
9. Village Ergneti, Church of the Virgin
10. Village Variani, Home-museum of Iakob Gogebashvili
11. Village Shindisi, Castle of Shindisi.

Many other ancient churches can be identified at www.mygeorgia.ge. Typical examples of local heritage are shown below. In addition, several cultural heritage elements can also be seen in the area beyond "listed" buildings, i.e., those protected by the State (source: Council of Europe PIAG Program, http://www.coe.int/t/dg4/cultureheritage/cooperation/piag).

		
Zemo Nikozi	Deity Church	Bell-Tower

(Source: mygeorgia.ge)

4.1.6 Project Beneficiaries

According to the diagnostic report *(Joint FAO/UNICEF/WFP Food Security, Child Nutrition and Agricultural Livelihoods Assessment*. February 2009, Georgia, available at http://home.wfp.org/stellent/groups/public/documents/ena/wfp211532.pdf), the Tiriponi and Saltvisi irrigation area include at least 34 villages with over 24,000 households engaged in agriculture, including 1,000 households of IDPs and households damaged by the war of 2008.

Shida Kartli has the highest incidence of poverty (59.4%) of all the regions in Georgia. According to the World Food Programme (WFP) baseline assessment of 2004, agriculture in this area is predominantly horticulture and the overall food insecurity level is classified as 'low.'

Communities were asked in the WFP report to identify their greatest needs to restore their livelihoods. The top three priorities relate to agriculture: farm machinery (70%); fertilizers (70%), and irrigation water (50%). Most villages felt the water source from former South Ossetia was unreliable and alternate sources must be considered to ensure long-term food security. This involves rehabilitation of channels and head works. Some villages even require cleaning of existing irrigation channels. Limited precipitation and lack of snow may create drought conditions in the near-term, further reducing crop productivity and increasing dependency on irrigation systems.

The Tiriponi and Saltvisi irrigation systems provided irrigation that allows for diversity in the farming system. Agricultural production (primarily apples) in Shida Kartli region accounted for 12% of the national GDP prior to the 2008 conflict. Vegetable production was also significant. Livestock and cereal production were important components of the farming system, produced primarily for domestic use and animal feed. Livestock also added dietary diversity and enabled families to generate small but regular income through sales of cheese. This process was disrupted due to irrigation problems caused by the 2008 conflict.

The project beneficiaries mainly produce fruit and vegetables. Fodder crops and cereals are cultivated on the remaining land. Shida Kartli contributes one-tenth of national wheat production. Farmers tend to use seeds from the previous harvest for three to five years. This

factor, combined with limited machinery and fertilizers, and poor plant protection measures, results in rather low yields. Wheat and barley are produced mostly for human consumption, while maize is mainly for animal feed. All cereal byproducts are used to feed animals. The KAV feasibility study found that the Tiriponi/Saltvisi rehabilitation project will increase total agricultural production by 4.5 times to $33.9 million. Productivity is expected to increase from $400 to $1,700 per hectare (Table 4.3).

Table 4.3: Total Value of Products in Tiriponi/Saltvisi Irrigation Scheme

#	Agricultural lands	Unit market price (USD)	Actual			Projected		
			Area Ha	Yield unit/ha	Total products ('000 USD)	Area Ha	Yield unit/ha	Total products ('000 USD)
1	Autumn wheat	24.3	2400	15.0	874.8	2400	25.0	1458.0
2	Spring wheat	21.2	1000	13.0	275.6	2400	20.0	1017.6
3	Maze	24.3	1000	10.0	243.0	2500	25.0	1518.75
4	Vegetables	24.0	1700	50.0	2040.0	3550	120.0	10224.0
5	Perennial grasses	15.4	5458	10.0	840.5	590	60.0	545.16
6	Annual grasses	6.1	4500	15.0	411.75	568	50.0	173.24
7	Fruit orchards	24.2	3850	30.0	2795.1	7700	100.0	18634.0
8	Vineyards	24.2	150	20.0	72.6	350	40.0	338.8
	Total		20058		7553.35	20058		33909.55

4.2 Geographic Characteristics

Georgia is a mountainous country covering 70,000 km^2, situated between the south slope of the Caucasus Mountains, the east coast of the Black Sea and the northern edge of the Turkish Anatolia plain. The country is characterized by varied topography. It lies mostly in the Caucasus Mountains and its northern boundary is partly defined by the Greater Caucasus range. The Lesser Caucasus range, which runs parallel to the Turkish and Armenian borders, and the Surami and Imereti ranges which connect the Greater Caucasus and the Lesser Caucasus, create natural barriers that are responsible for climatic differences among eastern and western parts of Georgia. Earthquakes and landslides in mountainous areas are a significant threat to life and property. Among recent natural disasters, there were massive rock and mudslides in Adjara in 1989 that displaced thousands in southwestern Georgia and two earthquakes in 1991 that destroyed several villages in north-central Georgia and South Ossetia.

The Tiriponi Valley, irrigated by the Tiriponi and Saltvisi irrigation schemes, is located in eastern Georgia and belongs to the Shida Kartli Plain. The Valley is bordered by the Tiriponi main channel from the North, by Lekhuri River from the East, by Kvernaki Hill from the South, and by the Didi Liakhvi River from the West. The Didi Liakhvi provides much of the water to the Tiriponi and Saltvisi systems. The elevation of the Tiriponi Valley ranges from 600-800 m ASL.

From a geomorphologic standpoint, the project area belongs to the Shida Kartli Ravine located between greater and lesser Caucasus. The four rivers (Tortla, Mejuda, Pshana, and Didi Liakhvi)

flow from the north to south across the Tiriponi-Saltvisi plain, which is slightly inclined to the south. The Gori depositional plain is developed within the Tortla-Liakhvi section. Its relief is characterized by an abundance of terraces inclined to the south, built mainly of pro-alluvial and alluvial sediments.

Geologically, the territory is represented by conglomerates of Quaternary Age and alluvial sediments containing limestone on the surface with float stone layers filled with loam, loamy sand and sand. The Tiriponi Valley is dissected by streams of the Patara Liakhvi, Mejuda and Tortla Rivers as well as by irrigation channels. Surface waters quickly percolate from old alluvial and alluvial soils. The soils are light soils that are highly porous. Soils need intensive irrigation for productivity.

4.3 Land Use Characteristics

As mentioned above, the Shida Kartli Region is primarily characterized by agricultural land use. Farmers cultivate fruits and vegetables, annual crops, vine grapes, and also raise livestock, mainly cows, sheep, and pigs. In mountainous and hilly areas, pasture for livestock is the prevailing land use, whereas on the ravine from Gori to Khashuri, fruit plantations (apples, peaches, plums, etc.) are more common. Vineyards, maize, vegetables, potato, melons, and other crops are also grown in ravines. In the area covered by the Tiriponi and Saltvisi irrigation scheme, farmers mainly cultivate annual crops including maize, vegetables, potato, and melons. Some families have greenhouses where they grow vegetables (tomato, cucumber, greens) and flowers. Crops and land use in the Tiriponi and Saltvisi irrigation areas (current versus projected after rehabilitation works) is shown in Table 4.4.

Table 4.4: Crops and Lands in the Tiriponi and Saltvisi Irrigation Areas

#	Agricultural lands	Actual		Projected	
		Areas (ha)	% of total area	Areas, ha (watering)	% of total area
1	Autumn wheat	2400	11.97	2400 (2)	11.97
2	Spring wheat	1000	4.99	2400 (2)	11.97
3	Maze	1000	4.99	2500 (3)	12.46
4	Vegetables	1700	8.47	3550 (4)	17.7
5	Perennial grasses	5458	27.21	590 (5)	2.94
6	Annual grasses	4500	22.43	568 (2)	2.83
7	Fruit orchards	3850	19.19	7700 (3)	38.39
8	Vineyards	150	0.75	350 (3)	1.74
	Total	20058	100.0	20058	100.0

4.4 Environmental Baseline Information

This section is divided into two subsections: physical resources (climate, air, water resources, soils, surface water, groundwater, and cultural and historic resources) and biological resources (biological diversity, endangered, threatened and protected species and their habitats, protected areas, vegetation including important habitats, wildlife and other land resources). It describes the area that may be affected by the proposed action and alternatives.

The *affected environment* of the proposed project is the Saltvisi and Tiriponi Valley (located in eastern Georgia and belonging to the Shida Kartli Plain). The project area can be identified as that area bounded by the Saltvisi and Tiriponi main canals from the north, by Lekhuri River from the east, by Kvernaki Hills from the south, and Eastern Phrone River from the west. The Saltvisi and Tiriponi areas are divided by the Didi Liakhvi River, which is the main source of water for both irrigation schemes. Upstream, the project area is hydrologically connected with the catchments of Didi and Patara Liakhvi and other rivers crossing the valley, while downstream all rivers essentially discharge at the confluence near Gori Municipality. These irrigation canals and rivers join the largest river of Georgia, the Mtkvari, which flows in a west-east direction.

4.4.1 Physical Resources

Climate. The Shida Kartli Plain is characterized by moderately humid subtropical climate and semi-humid continental climate with hot summers and warm winters and a high index of solar radiation balance (120-130 kcal/cm2). The average annual temperature is 10.9 Cº, average annual precipitation is 585 mm, while summer gets 140 mm of precipitation and winter average is 114 mm. The average humidity is 0.66 %.

The tables below provide data from the meteorological stations located close to the Tiriponi irrigation system and include average monthly, annual and extreme temperatures and precipitation.

Table 4.5: Average Monthly, Annual and Extreme Temperatures (°C)

Meteorological station	Temperature	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Gori	Average	-1,2	0,2	4,8	10,3	15,7	19,1	22,2	22,3	18,0	12,3	6,0	0,9	10,9
	Abs. Maximum	16	19	28	31	34	38	38	40	37	32	25	18	40
	Abs. Minimum	-28	-26	-20	-9	-3	2	6	5	-3	-9	-18	-24	-28
Tskhinvali	Average	-1,8	-1,0	3,2	8,7	13,9	17,3	20,3	20,5	16,3	11,1	5,1	0,5	9,5
	Abs. Maximum	16	17	25	29	31	34	36	36	34	28	25	18	36
	Abs. Minimum	-28	-25	-17	-8	-2	4	4	5	-3	-8	-17	-23	-28
Mejvriskhevi	Average	-1,3	-0,2	3,9	9,2	14,4	17,6	20,5	20,9	16,7	11,5	5,4	0,8	10,0
	Abs. Maximum	16	19	26	29	31	35	38	37	35	31	25	20	38
	Abs. Minimum	-28	-25	-16	-7	-3	3	5	5	-3	-8	-17	-22	-28

Orographic conditions of the region and significant distance from the Black Sea result in conditions of relatively low precipitation, with annual distribution characterized by a high maximum in May and October. Annual average and total precipitation based on observation data from the surrounding stations are shown below.

Table 4.6: Average Monthly and Annual Precipitation (mm)

Meteorological station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Gori	42	47	45	52	76	62	44	34	43	48	47	45	585
Tskhinvali	57	60	58	61	79	66	49	41	52	61	59	53	696
Mejvriskhevi	41	44	44	54	80	65	46	35	45	51	49	46	600

Drought periods are characteristic of the entire territory of the Shida Kartli Plain. The length and intensity of droughts are not as long as drought periods in the subzones of Gori and Saguramo-Mukhrani.

Freezing starts in October to late November and ends in March or April, however freezing of soil does not occur, and maximum freezing depth does not exceed 5 cm. In terms of climate, some limitations will apply for construction seasons; however it is possible to conduct construction activities year round.

Air. In several towns and regional centers, there are special Hydrometeorology Department units for monitoring the environment, where observations of air quality are carried out on a regular basis (on general and specific pollutants). However, the existing air quality data are very limited at most of the project sites. In general, in Gori, air pollution is low and air quality is good, especially in the rural countryside.

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Water Resources in the Project Area. The area irrigated by Tiriponi and Saltvisi is dissected by numerous rivers (Patara Liakhvi, Akura, Mejuda, Tortla, Lagomakhevi, Bersheula, and Charebula). One of the most significant factors determining the operational capacity of the irrigation systems is the hydrology of the region and primarily the hydrological properties of the rivers used as a source of irrigation water. The primary source of water is from the Kvemo Nikozi diversion dam and pump station located on the Didi Liakhvi River. The system previously received water via the head works at Tskhinvali. Because of the closure after the 2008 conflict, the GoG constructed the Kvemo Nikozi diversion dam and pumping station several kilometers downstream of Tskhinvali. The capacity of the pumps serving the Tiriponi system is ten m^3/s and the water is pumped directly to the main canal. A second source of water for the Tiriponi system is the Patara Liakhvi River through a gravity flow diversion at Karbi Headworks (2 m^3/s). Some of the other rivers are used for local irrigation, such as Dzevera-Shertuli, Gardigardmo, Tkviavi-Marani, Mejvriskhevi, Rekha and Tortiza. These waterways irrigate about 2,000 hectares by gravity flow.

Didi Liakhvi River

For the Tiriponi and Saltvisi irrigation systems, the main water source is Didi Liakhvi River which has an annual average flow of 29.8 m^3/s at the Tiriponi/Saltvisi diversion site. River Didi Liakhvi originates at Goluata village, at 2337.7 m altitude and falls into Mtkvari/Kura River from the left side, at 972 m above sea level at Gori. The length of the river is 98 km; the total fall – 1755 m; average slope – 17.9%; area of the catchments basin – 2440 km^2; and average altitude of the basin – 1590 m. The river system includes numerous tributaries totaling 1800 km in length, including Patara Liakhvi (63 km length) and Mejuda (46 km length).

The river regime is characterized by spring floods and low flows in winter. The river is fed from rain, snow, glacier and groundwater. Thirty to 39% of the annual flow is provided in spring, 37-42%; in summer, 14-16%; in autumn and 8-9% in winter. For calculation of the average annual flow of Didi Liakhvi River, at Ergneti village (near village Kvemo Nikozi), 47 years of data (1942-1990) from the hydro power station Kekhvi was used. Average annual flows at Kekhvi varied from a minimum in 1951 of 17.9 m^3/sec to a maximum of 53.3 m^3/sec (1987) with an

average of 27.3 m^3/sec. When adjusted for the new downstream diversion site at Ergneti this is estimated at an annual average of 29.8 m^3/s.

Table 4.7 provides quantities of water to be taken from Didi Liakhvi and average annual distribution of flows for various occurrence probabilities (25%, 50%, 75%).

Table 4.7: Didi Liakhvi River – Village Ergneti

Months	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Average flow with 25% occurrence probability													
Average annual flow at Kekhvi PS cross-section	11.2	11.0	16.8	50.5	79.3	72.2	45.1	27.7	19.7	17.4	16.0	13.5	31.7
Water intake by Kekhvi and Dzartsemi irrigation systems	0.50	0.50	0.50	2.94	0.68	2.00	3.98	4.79	1.90	0.50	0.50	0.50	1.61
Flow remained in Didi Liakhvi	10.7	10.5	16.3	47.6	78.6	70.2	41.1	22.9	17.8	16.9	15.5	13.0	30.1
Side inflow from Kekhvi to Ergneti	2.54	2.32	2.41	4.64	7.79	7.70	4.45	2.72	1.83	3.17	2.32	2.27	3.68
Liakhvi flow at Ergneti	13.2	12.8	18.7	52.5	86.4	77.9	45.6	25.6	19.6	20.0	17.8	15.3	33.8
Sanitary flow	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98
Quantity of water available for diversion	10.2	9.82	15.7	49.2	83.4	74.9	42.6	22.6	16.6	17.0	14.8	12.3	30.8
Average flow with 50% occurrence probability													
Average annual flow at Kekhvi PS cross-section	9.40	9.30	14.1	42.4	66.6	60.6	37.8	23.2	16.5	14.6	13.4	11.3	26.6
Water intake by Kekhvi and Dzartsemi irrigation systems	0.50	0.50	0.50	2.94	0.68	2.00	3.98	4.79	1.90	0.50	0.50	0.50	1.61
Flow remained in Didi Liakhvi	8.90	8.80	13.6	39.5	65.9	58.6	33.8	18.4	14.6	14.1	12.9	10.8	25.0
Side inflow from Kekhvi to Ergneti	2.14	1.95	2.03	3.91	6.56	6.49	3.75	2.29	1.54	2.67	1.95	1.92	3.10
Liakhvi flow at Ergneti	11.0	10.8	15.6	43.4	72.5	65.1	37.8	20.7	16.1	16.8	14.8	12.7	28.1
Sanitary flow	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98
Quantity of water available for diversion	8.02	7.82	12.6	40.4	69.5	62.1	34.8	17.7	13.1	13.8	11.8	9.72	25.1
Average flow with 75% occurrence probability													
Average annual flow at Kekhvi PS cross-section	7.85	7.69	11.8	35.4	55.4	50.6	31.6	19.4	13.8	12.2	11.2	9.46	22.2
Water intake by Kekhvi and Dzartsemi irrigation systems	0.50	0.50	0.50	2.94	0.68	2.00	3.98	4.79	1.90	0.50	0.50	0.50	1.61
Flow remained in Didi Liakhvi	7.35	7.19	11.3	32.5	54.7	48.6	27.6	14.6	11.9	11.7	10.7	8.96	20.6
Side inflow from Kekhvi to Ergneti	1.78	1.63	1.69	3.25	5.46	5.40	3.12	1.91	1.28	2.22	1.63	1.56	2.58
Liakhvi flow at Ergneti	9.13	8.82	13.0	35.8	60.2	54.0	30.7	16.5	13.2	13.9	12.3	10.5	23.2
Sanitary flow	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98
Quantity of water available for diversion	6.15	5.84	10.0	32.8	57.20	51.0	27.7	13.5	10.2	10.9	9.32	7.52	20.2

Downstream from the new Tiriponi head works on both sides of Didi Liakhvi, there are four to five villages with a combined population of up to 1000 households. These water users/villages divert Didi Liakhvi waters for irrigation. Total downstream use of Didi Liakhvi water is estimated at 2.5 m^3/sec. There is no Didi Liakhvi water diverted for use in Gori city.

Groundwater and irrigation return flow contribute to recharging the river. Even in the low summer flow period, 3-4 m^3/sec flow is maintained in Didi Liakhvi where it joins Mtkvari/Kura.

The tables below show maximum and minimum flows in Didi Liakhvi River at Ergneti village. The tables show that the flow of the Didi Liakhvi River remains high during low-flow periods in the growing season.

Table 4.8: Maximum Water Flows of Didi Liakhvi River at Village Ergneti

Occurrence probability (%)	1	2	5	10
Recurrence interval (Years)	100	50	20	10
m^3/sec	845	715	530	450

Table 4.9: Ten-Day Minimum Flows for Didi Liakhvi River During Vegetation Period (m^3/sec)

	Watershed ($km^{2)}$	Occurrence Probability (%)						
		50	75	80	90	95	97	99
Village Ergneti	1030	16.1	12.8	12.2	10.3	9.10	8.20	6.87

Patara Liakhvi River

The Patara Liakhvi River originates from the springs located on the northwest slope of Cheparukhi Mountain, in the western part of Lomisi Mountain Ridge, and falls into the River Didi Liakhvi at the village of Shertuli. The length of the river is 63 km; total downgrade is 1960 m with an average slope of 31.1%; the catchments basin is 513 km^3; and the average altitude of the basin is 1850 m.

In 1980, the Zonkari dam and reservoir were completed (32.5 km from the confluence with Didi Liakhvi River) for irrigation of up to 21,000 ha. The total storage volume is 39.0 million m^3. The fall from the reservoir to its confluence is 1625 m with an average slope of 50%; the catchment basin is 268 km^3; and average altitude of the basin is 2130 m. The Patara Liakhvi River is fed basically by rain and snow waters. The role of groundwater feeding is secondary. Its regime is characterized by spring floods and summer to autumn high waters and relatively stable low flow in winter. 44.7% of the annual flow is in spring, 33.5% in summer, 21.1% in autumn and 9.7% in winter. Average annual flow, based on data from Vanati hydro-power station, located ten km below the Zonkari reservoir varies from 5.19 m^3/sec to 18.0 m^3/sec.

Average annual flow of Patara Liakhvi River at the Karbi head works, where additional supply to the main channel of Tiriponi irrigation is diverted, was estimated for the unlikely scenario where the entire river flow is first stored in the Zonkari reservoir. Under this scenario the total downstream river flow for an occurrence probability of 75% is 157 million m3.

Water is diverted above the Karbi off-take for the Vanati irrigation system. Between the Vanati head facility and the Karbi head works, there are several small local channels that take additional water from the river. Under the expected conditions where inflows to the Zonkari reservoir are not stored, it is still possible to supply up to 2 m^3/sec water flow to Tiriponi irrigation system via Karbi headworks.

Mejuda River

The Mejuda River originates on the southern slope of Dzirisi Mountain (2994.6 m) and falls to the Didi Liakhvi River at Gori. The length of the river is 46 km with an average slope of 30%. There are 79 tributaries of 278 km total length which flow into the river. Among them, the most significant are Adzula (26 km length) and River Western Tortla (31 km length). The Mejuda River is fed from rain, snow, and groundwater. Its regime is characterized by spring floods and

variable low flows during other seasons. About 53.7% of the annual flow occurs in spring, 20.7% in summer, 11.6% in autumn, and 14% in winter.

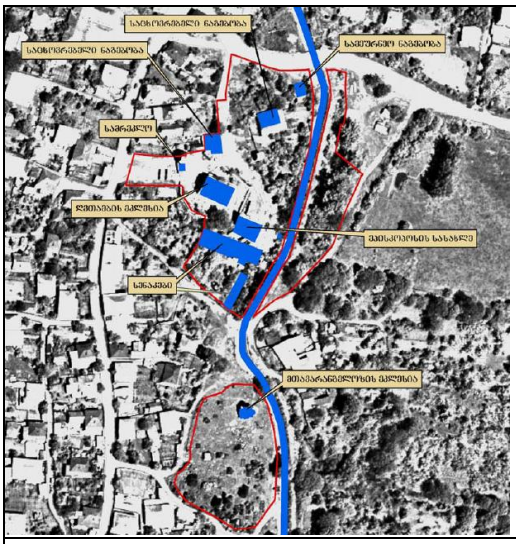
Groundwater. The renewable groundwater resources at the national level are estimated at 17.23 km^3/year, of which 16 km^3/year are drained by the surface water network. This gives a total of 58.13 km^3/year for internal renewable water resources (IRWR). The total actual renewable water resources (ARWR) are 63.33 km^3/year. In 1990, the total water abstraction was estimated at three km^3/year from some 1,700 tube-wells. According to a recent assessment, another seven km^3/year could be sustainably abstracted in the future. Groundwater use was not greatly developed during the Soviet period, due to the emphasis on large-scale, state-run surface irrigation schemes.

In the project area, all villages have shallow wells used primarily for drinking water and occasionally for kitchen gardens. The water table at many location is high. The shallowest wells have water at two meters and the deepest wells have water at 80 meters. As such, it may be possible to increase the number of shallow wells to provide water for kitchen gardens. Tapping into the shallow water table should not affect the water regime of deeper aquifers.

Cultural and Historic Resources. The feasibility study indicated that there were no cultural and/or archeological monuments within the project area, and that since this is rehabilitation of an existing system, the chances to discover, or risks of impacting archeological monuments was considered low. Nonetheless, the ESS recommended considering archeology and cultural heritage issues in more detail in the EA. At least one extremely important site, the Nikozi Cathedral Ensemble (V-XVI cc), was confirmed in the immediate proximity of the irrigation infrastructure.

Illustrations below are based on the documentation and presentations publicly available from the Council of Europe's "Post-Conflict Actions (PIAG) for the Social and Economic Revitalization of the Communities and the Cultural Environment in the Municipality of Gori" project (see http://www.coe.int/t/dg4/cultureheritage/cooperation/piag). It displays the location of the Nikozi Monastery Ensemble and existing irrigation canal in the Saltvisi scheme. In 2009, just upstream from this location, a water pipeline was placed (piped water is flowing from the dam and intake facility constructed at Didi Liakhvi).

The next illustrations show actual photographs of the same area. Several issues emerge: (1) Spoil is being extracted from the irrigation channel from time to time (locals interviewed quoted the last cleanup was in 2010) and it is indiscriminately dumped along the canal, degrading the landscape value of the historic complex. (2) The toilet of the monastery ensemble is located on the edge of the irrigation canal (locals reported the toilet is equipped with a pit). (3) Another ancient church is located just downstream and the proximity to the channel and repair works indicate the bank and slope are unstable and they have been armored with concrete stones. (4) Locals reported that the old Tskhinvali head works sometimes flushed irrigation waters through canals resulting in occasional strong flow rates with potential impacts on nearby cultural facilities. (The concrete slab bridge over the channel reportedly collapsed, blocking the stream flow.)



Zemo Nikozi Monastery Ensemble and irrigation channel in Saltvisi scheme

Artist's impression of the Zemo Nikozi Monastery, depicting irrigation channel as part of the landscape

(Source: PIAG)

'Cleaned' canal spoil has to be removed from the site to mitigate impact on the cultural heritage and landscape. Land plots on both sides of the canal belong to the Monastery in this location. Concrete slab bridge is also visible.

The project area is rich in historical and cultural heritage. Situations similar to Nikozi Monastery Ensemble are possible in other locations in the project area. There is always the possibility of archaeological chance-finds during rehabilitation of the irrigation schemes.

4.4.2 Biological Resources

GMIP sub-contracted a local biologist to visit the site as part of the EA Team, and his findings are incorporated into the section below.

Biological Diversity, Threatened, Endangered and Protected Species and their Habitats. The Caucasus is located in the Holarctic or Palaearctic kingdom depending on the terminology used by experts in zoogeographic zoning. The Tiriponi and Saltvisi irrigation system is part of the circumboreal sub-zone of the Caucasus region. This area is of lesser importance from the standpoint of animal biodiversity because of the long transformation of natural landscapes for agriculture and the dense human population.

Species on the Red List of Georgia that may occur in the project area are shown in Table 4.10. All bat species, 28 in total, recorded in Georgia are protected under the EUROBATS Agreement. The Red List, as well as EUROBATS, provides a legal instrument for the protection of listed species.

Table 4.10: Georgian Red List Species in the Project Area

Ref.	Scientific Name	Common Name	National Status	Kind of occurrence within area
		Mammals		
1	*Myotis emarginatus*	Geoffroy's bat	VU	At the northern edge of area
2	*Cricetulus migratorius*	Grey dwarf hamster	VU	Open landscape
3	*Mesocricetus brandti*	Brandt's hamster	VU	Open landscape
4	*Lutra lutra*	Common otter	VU	Rivers and channels
5	*Ursus arctos*	Brown bear	EN	Vagrant from forest north from area
		Birds		
1	*Haliaeetus albicilla*	White-tailed eagle	EN	Vagrant
2	*Buteo rufinus rufinus*	Long-legged buzzard	VU	Possibly breeding
3	*Aquila heliacal*	Imperial eagle	VU	Migrant, vagrant
4	*Aquila chrysaetos*	Golden eagle	VU	Vagrant
5	*Neophron percnopterus*	Egyptian vulture	VU	Feeding area
6	*Aegypius monachus*	Eurasian black vulture	EN	Vagrant, migrant
7	*Gyps fulvus*	Eurasian griffon vulture	VU	Vagrant, migrant
8	*Falco cherrug*	Saker falcon	CR	Migrant
9	*Falco vespertinus*	Red-footed falcon	EN	Migrant
10	*Aegolius funereus*	Boreal owl	VU	Possibly breeding
11	*Grus grus*	Grey crane	EN	Migrant
12	*Panurus biarmicus*	Bearded parrotbill	VU	Possibly breeding
		Reptiles		
1	*Testudo graeca*	Mediterranean tortoise	VU	Open landscape
		Bony Fishes		
1	*Salmo fario*	brook trout	VU	Rivers and channels
2	*Sabanejewia aurata*	Golden spined loach	VU	Rivers and channels
		Invertebrates		
		Butterflies		

Ref.	Scientific Name	Common Name	National Status	Kind of occurrence within area
1	*Manduca atropos*	Death's head sphinx	EN	Forest edges
2	*Callimorpha dominula*	Tiger moth	VU	Agrocoenosises
3	*Polyommates daphnis*	Meleager's blue	VU	Arid, open landscapes
		Bumble bees		
2	*Bombus persicus*	Persian humble-bee	VU	Open landscape
3	*Xylocopa violacea*	Violet carpenter bee	VU	Open landscape
		Dragonflies		
1	*Onychogomphus assimilis*	Dark pincertail	VU	Rivers and channels

As shown on Table 4.10, five mammal species included on the Red Data List of Georgia may occur in the project area. They are the common otter (*Lutra lutra*), Brandt's hamster (*Mesocricetus brandti*), and gray dwarf hamster (*Cricetulus migratorius*). According to locals the brown bear (*Ursus arctos*) penetrates into the project area in winter from neighboring forests that are to the north of the main channels of Tiriponi and Saltvisi irrigation systems. Geoffroy's bat may also be found in the project area.

Georgia is located in the Euro-African and Euro-Asian migration routes for birds. Bird migration takes place from west to east along the Mtkvari valley (from Khashuri to Tbilisi) from early March to mid-May. In late August to late November the birds migrate from east to west. Up to 120 bird species and one million individuals migrate through the Mtkvari valley (in both directions) in Georgia. In total, 243 bird species are recorded within the Didi Liakhvi basin. About 150 of them are local breeders (nesting species), 57 regular migrants, 28 species are wintering, and eight species are vagrant or occasional visitors. Within the project area, on the plain, there are 89 species of birds. Among them 19 species are found in open landscape, 21 species in urban and rural settlements, 13 species use riparian habitat, and about 30 species prefer bushes and forest edges.

Twelve bird species on the Red List of Georgia may occur in the project area (Table 4.10). Of these, three species could be nesting; others are migratory or vagrant visitors to area. The Egyptian vulture regularly feeds in the area, but the nearest known nest is out of the project area on Kvernaki Ridge.

Up to14 reptile species could be expected to occur within the project area; one of these species (Mediterranean tortoise) is included on the Red List of Georgia. The tortoise often lays eggs on the banks of streams and possibly on the banks of irrigation channels. The European marsh turtle (*Emys orbicularis*) can form large aggregations in stagnant and slowly moving waters of irrigation canals. There is one reptile that is a regional endemic of the Caucasus – the Kura lizard (*Darevskia portschinskii)*. Generally, rock lizards are highly dependent on specific rocks that are rich in insects.

Six amphibian species may be found within the region of the project, none of which is on the Red Data List of Georgia. Most numerous and sensitive to perturbations is the marsh frog (*Rana*

ridibunda), which forms large associations in ponds and in floodplains of river. One amphibian endemic to the Caucasus - the Caucasian toad (*Bufo verrucosissimus*) occurs along the main channels on the northernmost part of the area. Ponds and streams are the critical habitat for this species during the breeding season early in spring.

Three fish species on the Red Data List of Georgia (Golden spined loach- *Sabanejewia aurata,* brook trout- *Salmo fario,* and Kura undermouth- *Chondrostoma cyri* may occur in the project area. Out of 14 fish species inhabiting River Liakhvi (all protected under the Bonn Convention), ten species can be encountered with variable frequency and abundance in the project area's sections of rivers, namely:

1. *Capoeta capoeta* (Khramulya)
2. *Chondrostoma cyri* (Kura Undermouth)
3. *Barbus lacerta cyri* (Kura Barbel)
4. *Barbus mursa* (Barbel - Mursa)
5. *Acanthalburnus microlepis* (Blackbrow bleak)
6. *Alburnoides bipunctatus eichwaldi* (Bystryanka)
7. *Neogobius cephalarges constructor* (Ginger Goby)
8. *Noemacheilus brandti* (Kura Stone Loach)
9. *Sabanejewia aurata* (Golden Spain Loach)
10. *Ponticola constructor* (Caucasian Goby)

Of these species, Nos. 4 and 5 are endemics of the Caucasus and No. 2 is included on the Red List of Georgia.

Available scientific data indicate that six invertebrate species protected by law may occur in the project area. These species include three butterflies, one bumblebee, one carpenter-bee, and one dragonfly. Among vertebrates, nine species are endemic to the Caucasus and may be found in the project area. Table 4.11 provides the names of the endemics and the EA Team's assessment of whether they may be affected by the proposed project.

Table 4.11: Species Endemic to the Caucasus in the Project Area

	Common name	**Latin name**	**Possibility of impact on the species**	**Biotopes and range of occurrence**
		MAMMALS		
1	Caucasian mole	*Talpa caucasica*	Middle	In fields and orchards – entire area
2	Radde's shrew	*Sorex raddei*	Low	Forest in northern part of area
3	Robert's vole	*Chionomys roberti*	Middle	Forest in northern part of area
4	Brandt's hamster	*Mesocricetus brandti*	Middle	Open landscape; South-east part of area, at Gori
5	Caucasian mouse	*Apodemus ponticus*	Low	Forests and orchards, entire area
		BIRDS		
1	Armenian gull	*Larus armenicus*	None	Vagrant, everywhere

2	Caucasian warbler	*Phylloscopus lorenzii*	None	Doubt species, occurs in orchards
		REPTILES		
1	Kura lizard	*Darevskia portschinskii*	Low	Very downstream, at Gori
		AMPHIBIANS		
1	Caucasian toad	*Bufo verrucosissimus*	Middle	Along the main channels; northern part of area

Protected Areas. Approximately 8% of the country is under protected area status (Chemonics International, 2000). The Map in Figure 4.1 shows the network of protected areas in Georgia. This EA and the scoping phase confirmed the finding of the feasibility study, that no protected areas, including national parks and protected forests, are located at or in the immediate vicinity of the project area. The Liakhvi Nature Reserve is located upstream of Patara Liakhvi (Figure 4.1).

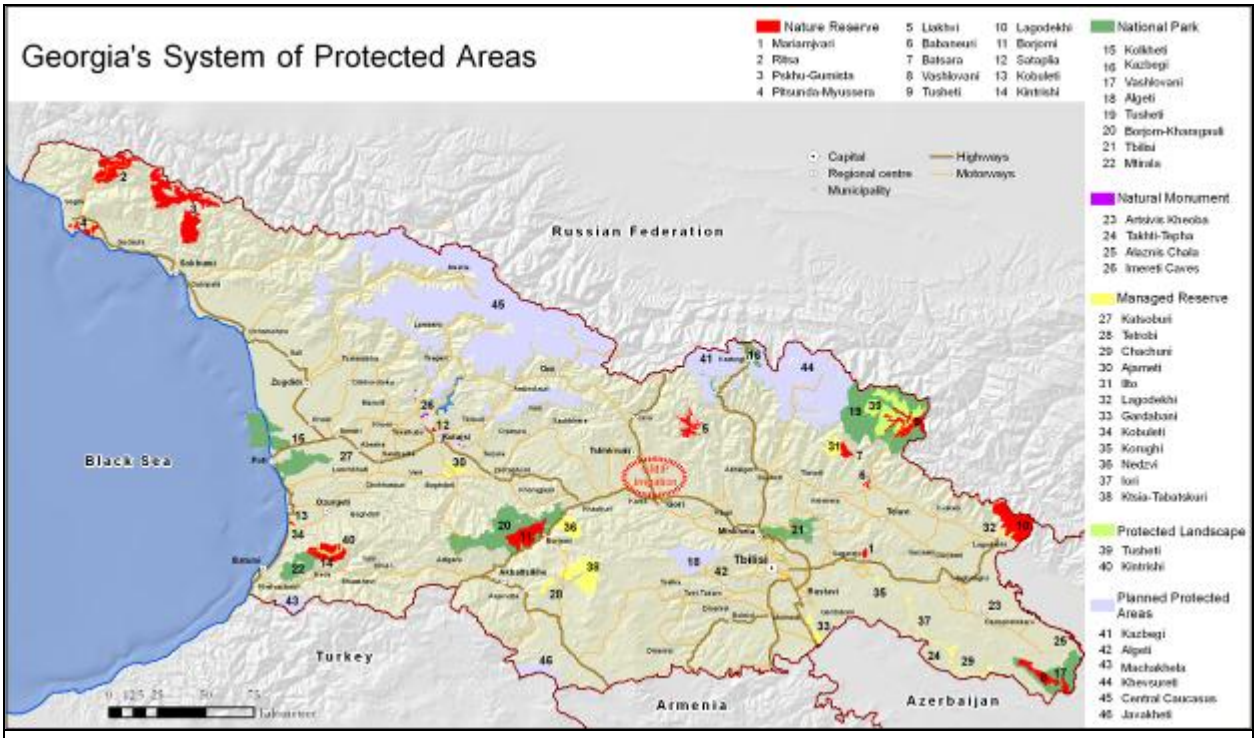


Figure 4.1: Map of Georgia's Protected Areas (source: Agency of Protected Areas of Georgia)

Ecosystems including Important Habitats. Major ecosystems found along the existing Tiriponi and Saltvisi irrigation schemes include industrial and urban ecosystems and agricultural landscapes. Most of the project area is represented by agricultural landscapes, which include orchards, arable and cultivated land, and pastures. The existing irrigation channels traverse arable land, which does not support rich fauna. However, edge habitat between agricultural land

and natural vegetation usually contains high species diversity and may provide valuable ecosystem functions. The agricultural land may provide habitat for some protected species (Brandt's and grey dwarf hamsters and Mediterranean tortoise).

There are no known large natural wetlands in the project area. Most wetlands in the project area are formed by discharged water from irrigation or leaks of water from damaged channels. Despite their manmade nature, the wetlands can provide shelter, feeding areas, stopover sites during migration, and wintering areas for many animal species.

Foothill and mountain deciduous forests occupy the slopes of hills and ridge (as shown in the photographs). Hills and foothills with xerophytic shrubbery are found in small areas near Gori.


Foothill vegetation


Foothill vegetation

Freshwater rivers and ponds in the project area are in a range of ecological conditions. They are important for fish, turtles, frogs, and aquatic invertebrates.

River bank ecosystems form narrow strips along the rivers. River banks serve as paths for animals to move around the adjacent agricultural landscapes, and provide shelter and stopovers for many animals and migratory birds.

Soils and land resources. In the Mtkvari valley, brown soils and gray forest soils (of medium and small thickness) are found. The land is productive and is used for agriculture.

Alluvial soils are found in the gorges of the rivers Didi Liakhvi, Patara Liakhvi, Mejuda, Ksani, Aragvi, Iori, and Alazani. In most of these gorges alluvial carbonate soils are in the initial stage of soil formation. The alluvial soils and old alluvial soils contain thick and medium thick loam and are characterized by low content of humus (2.0-2.5%). Alluvial wet soils, characterized by heavy mechanical consistency, are more abundant in the southern parts of the Tiriponi Valley (villages Kheltubani, Karaleti. and others).

The geographic distribution of soils in Georgia is shown on Figure 4.2 below. As can be seen, two main types of soil are present in the project area:

- Meadow-cinnamonic: these soils can be found in Kvemo and Zemo Kartli, in Kakheti and Meskheti regions. Their combined area is some 1180 hectares (1.7% of Georgia). These soils are characterized by poorly differentiated profile, with more profound profiles on cinnamon soils. They are distinguished by

weak alkaline or alkaline reaction, a low content of humus, carbonate, a loamy to clayey texture, accumulation of clay, high content of hygroscopic water, bulk density between 1.22 to 1.31 g / cc, a high to medium absorption capacity. The soils have moderate (0-10cm) to poor (10-20cm) content of hydrolysable nitrogen, have low content of mobile phosphorus and exchangeable potassium, and they are prone to water and wind erosion.

- Alluvial calcareous (calcaric fluvisols): these soils occupy some 2720 sq km (4.0% of Georgia). These soils are characterized by neutral or alkaline reaction, low humus content, high content of hygroscopic water, high absorption capacity, loamy or clay texture. The soils have medium (0-10cm) to poor (10-20cm) content of hydrolysable nitrogen, have slight to moderate content of total phosphorus, low or medium content of total potassium, and medium to low content of exchangeable potassium. They are prone to wind erosion.

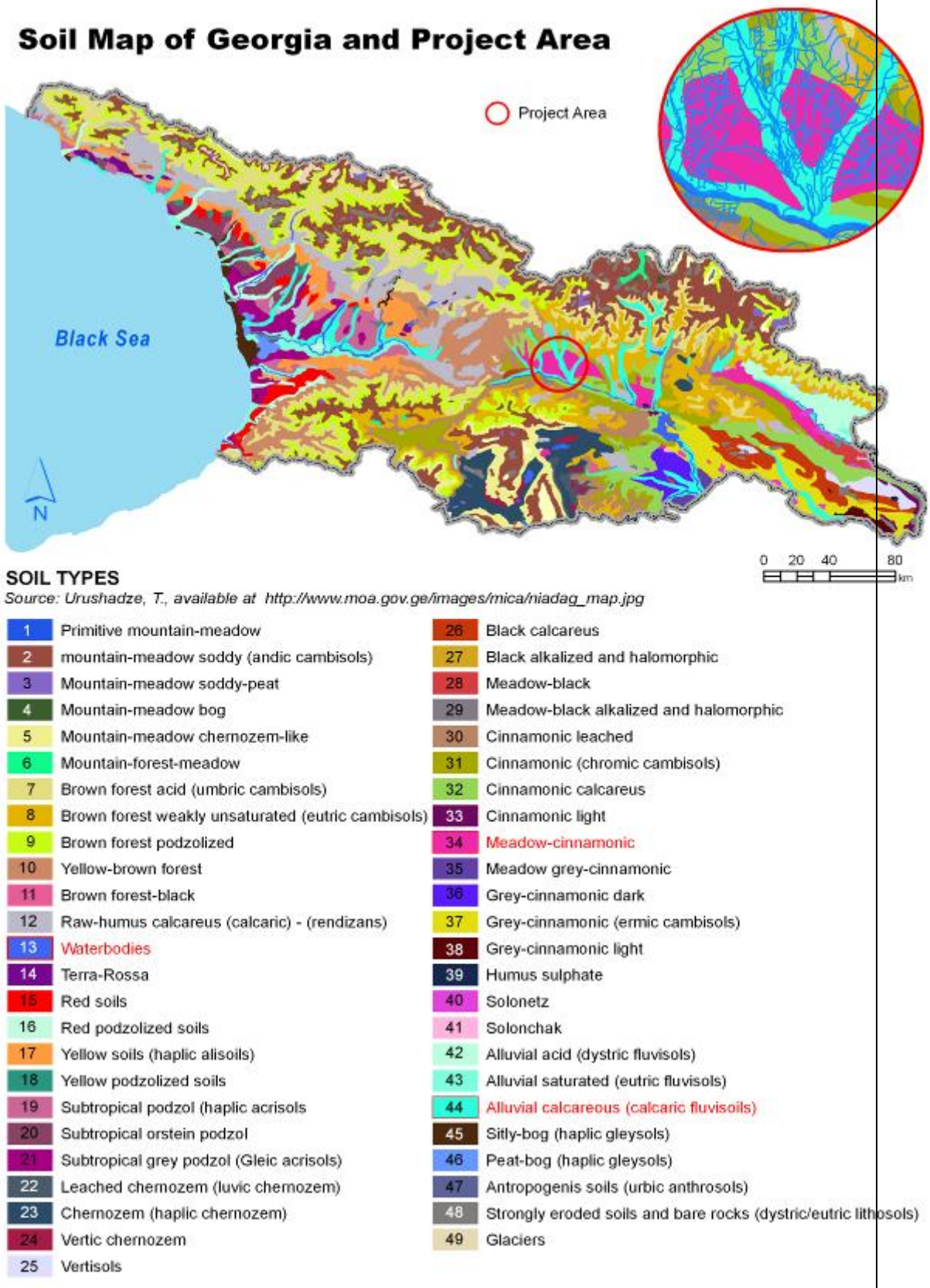


Figure 4.2: Map of Georgia's Protected Areas (source: Agency of Protected Areas of Georgia)

Due to improper operation of the irrigation schemes among other poor practices, erosion is common in many areas. Water-born erosion causes deepening of irrigation channels and collectors, creating ravines, and degrades soil surfaces. Some areas are waterlogged due to improper operation of irrigation channels. In other places, groundwater levels rise due to leaks in irrigation channels, causing excessive swamping.

4.5 Policy, Legal, Regulatory and Permitting Requirements

While there is no separate policy document that directly spells out Georgian policy for protecting and managing water availability and quality, the Law on Water does outline a number of key principles that comprise a policy framework (UNECE, 2003). Some of these are:

- Water protection is a major element of environmental protection for Georgian citizens, in view of both current and future needs;
- Drinking water for the population is the highest priority of all uses;
- Both groundwater and surface water are under state control;
- Management of water varies according to hydrologic importance;
- System of "user-polluter pays" is key;
- Pollution is not allowed, although a definition of what constitutes pollution is lacking.

There are more than ten major laws in Georgia that influence the protection and management of water resources and associated environmental concerns. The most comprehensive is the above Law on Water, which has been in force since October 1997 and was last amended in June 2000. The 96 separate articles of this Law cover a very wide and comprehensive set of issues, such as pollution control policies, protection of drinking water sources, licensing of water use and discharge, categorization and protection of resources, particular measures for the Black Sea, flood control, and many others. All surface water, groundwater and near-coastal water are deemed to be under the control of the national government. Many of the provisions of the Law are supplemented by legislative orders and decrees, as well as by regulations of the Ministry of Environment Protection and Natural Resources, which specify necessary actions in greater detail. The Ministry holds responsibility for implementing the Law on Water, although other ministries are key players on specific topics. The Law is implemented by personnel at the regional or municipal level. The Law on Water provides for the licensing of water use and the discharge of pollutants, an approach that has been in place since 1999.

Regardless that Georgia is a country with abundant fresh water resources; the current water supply situation is extremely complicated. This is largely due to anthropogenic contamination, a deficit of drinking water, and low sanitary standards of the water supply system. Because of the degradation of the water supply and sewerage infrastructure, the quality of drinking water often does not comply with human health and safety standards. Some 38% of the water pipeline system of the cities and regions belongs in the high-risk water pipeline category, in which the microbiological contamination index is high.

4.5.1 Host Country Government Policy, Legal, and Regulations

A number of Georgian laws and regulations exist related to environment, social, labor, land, cultural heritage, and other technical issues, which are relevant to this EA.

The Constitution of Georgia sets general regulating principles of environment protection. Namely, Article 37, Clause 3 states that all citizens have the right to live in a healthy environment and use natural and cultural surroundings. In addition, citizens are obliged to protect the natural and cultural surroundings. Below is provided a list of the principle environmental, social, health care, cultural heritage, and technical laws and regulations.

Table 4.12: Principal Laws and Regulations Relevant to the Project

Year	Law / Regulation
	Environment
1994	Law on Soil Protection
1996	Law on System of Protected Areas
1996	Law on Protection of Environment
1996	Law on Mineral Resources
1997	Law on Wildlife
	Transit and Import of Hazardous Waste within and into the Territory
1997	Law on Water
1998	Law on Hazardous Chemicals
1998	Law on Pesticides and Agrochemicals
1999	Law on Protection of Ambient Air
1999	The Forestry Code of Georgia
1999	Law on Compensation of Damage from Hazardous Substances
2000	Law on Regulation and Engineering Protection of Sea, Water Bodies and Rivers
2005	Law on Red List and Red Book of Georgia
2006	Law on Licenses and Permits
2007	Law on Status of Protected Areas
2007	Law on Ecological Examination
2007	Law on Service of Environmental Protection
2007	Law on Environmental Impact Permit
2002	Regulation on Environmental Impact Assessment (approved by the Order No. 59 of the Minister of Environment).
	Cultural Heritage
2007	Law on Cultural Heritage
	Social, health and labor issues
1997	Law of Georgia on Healthcare
1997	Law on Professional Unions
2006	Labor Code of Georgia
2007	Law on Public Health
	Land ownership and land take
1996	Law on Land Registration
1996	Law on Agricultural Land Ownership
1997	The Civil Code of Georgia

1997	The Civil Procedural Code of Georgia
1996	The Law of Georgia on Ownership of Agricultural Land
1999	The Law on Rules for Expropriation of Ownership for Necessary Public Need
2005	Law on Privatization of State-Owned Agricultural Lands
2010	Law on State Owned Property
2007	Law of Georgia on Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law
2007	Law on Replacement Cost Reimbursement and Compensation for the Use of Agricultural Land for Non-Agricultural Purposes
2007	Presidential Decree #525 on Rules for Entitlement of Ownership Rights to Lands Possessed (Employed) by Physical and Legal Persons of Private Law and Approval of Ownership Certificate Format
	Various
1977	Law on Resorts and Sanitary Protection of the Resort Zones
2005	Law on Licenses and Permitting

The environmental permitting system in Georgia is regulated by the Law on Environmental Impact Permit, Law on Licenses and Permits, Law on Ecological Assessment, and Law on Licenses and Permits. These laws are described in the section on Relevant and Applicable Permitting Requirements, below.

Law of Georgia on Protection of Environment

This law regulates the legal relationship between the bodies of the state authority and the physical/legal persons regarding environmental protection and use of natural resources on Georgian territory, and defines responsibilities of state institutions. The law gives major principles for environmental management, licensing, standards, EIA, and related issues and describes different aspects of the protection of ecosystems, protected areas, and biodiversity.

Law of Georgia on Natural Resources

The law defines the status of natural resources, describes their use, and sets out the types of licenses and rights and obligations of the users. The law sets responsibilities to preserve lands from contamination and ensures conformity of agricultural activities with relevant legal requirements. It describes economic principles for consumption of natural resources.

Law of Georgia on Soil Protection

The law aims at ensuring preservation of soil integrity and improving its fertility. It defines obligations and responsibilities of land users and the state regarding provision of soil protection conditions and ecologically safe production. The law sets the maximum permissible concentrations of hazardous matter in soil. It also restricts the use of fertile soil for non-agricultural purposes; execution of any activity without stripping and preserving topsoil; open quarry processing without subsequent re-vegetation of the site; terracing without preliminary survey of the area and approved design; overgrazing; wood

cutting; damage of soil protection facilities; any activity that would degrade soil quality (e.g., unauthorized chemicals/fertilizers, etc.).

Law of Georgia on Protection of Atmospheric Air

The law regulates protection of atmospheric air from adverse anthropogenic impact within the whole Georgian territory (Part I, Chapter I, Article 1.1). Adverse anthropogenic impact is any human-caused effect on atmospheric air causing or capable of causing negative impacts on human health and the environment (Part II, Chapter IV, Article II.I).

Law of Georgia on System of Protected Areas

The law sets out the categories of protected areas (including national parks, state reserves, managed reserves, etc.) and defines activities allowed in their boundaries. Activities may be allowed based on purpose of the area, requirements set out in legislation and individual regulations, management plans of protected areas, as well as international agreements and conventions signed by Georgia. The law provides restrictions of the use of natural resources in national parks and other protected areas.

Law of Georgia on Cultural Heritage

The Law of Georgia on Cultural Heritage among others envisages protection measures for newly identified objects of cultural heritage. In accordance with the legislation the expertise of the newly identified objects of cultural heritage is the responsibility of the Ministry of Culture and Monument Protection of Georgia. In particular, the Law provides (Volume II, Chapter III, Article 101, Item 1) that if any physical or legal entity reveals or discovers cultural heritage or supposes sufficient justification for the existence of such objects during the activities that may damage, destroy or cause danger to it, the entity who conducts such activities is obliged to immediately suspend activities and inform the Ministry about the reveal or suppositions on existence of cultural heritage and suspension of activities.

Law of Georgia on Water

The law regulates protection and consumption of surface and ground water, commercial water production, protection of aquatic life, fauna, flora, forest, land and other natural resources. Consistent with the legislation, water within the territory of Georgia is under state ownership.

Law on Rules for Expropriation of Ownership for Necessary Public Needs

The state has the constitutional power to seize any property by means of expropriation for projects of imminent public necessity. The expropriator has to make every reasonable effort to acquire property by negotiation and is required to value the property in accordance with the fair market value before negotiations.

Law on Replacement Cost Reimbursement and Compensation for the Use of Agricultural Land for Non-Agricultural Purposes

The law specifies requirements for a land replacement fee (based on location and quality of land) to compensate the government and private landowners/ land users for property

loss, plus lost profits by the beneficiary as a result of allocation of agricultural land for nonagricultural purposes.

Labor Code of Georgia

The code regulates labor relations between all workers and employees in Georgia. It supports the realization of human rights and freedoms through fair reimbursement and the creation of safe and healthy working conditions.

4.5.2 International Standards and Best Practices

International standards that may apply to the project include the ILO core labor standards on:

- Forced labor (C105)
- Child Labor (C182)
- Discrimination (C111)
- Freedom of Association and the Right to Organize (C 87)
- Equal Remuneration (C100)
- Minimum Age (C138)

Georgia is a party to the following environmental conventions and treaties, not all of which will be relevant to the project:

- Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat
- UN Rio de Janeiro Convention on Biological Diversity
- Convention on Migratory Species
- Aarhus Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters
- European Archaeological Heritage Convention
- European Convention on Protection of the Archaeological Heritage (Lavallette, 1992 – 01 – 16) – Georgia joined the convention on February 23, 2000, pursuant to Decree # 158; and
- European Convention on Protection of the Archaeological Heritage (Granada, 1985-10-03) – Georgia joined the convention on February 23, 2000, pursuant to Decree # 157.

Georgia is also party to the following cultural heritage and archeology conventions:

- European Convention on Archaeological Heritage Protection (London, 1969).
- Convention on World Cultural and Natural Heritage Protection (Paris, 1972).
- European Convention on Architectural Heritage Protection (Grenada, 1985).
- Convention on Archaeological Heritage Protection (La-Valletta, 1992).
- European Convention on Landscape Preservation (Florence, 2000).

4.5.3 Relevant and Applicable Permitting Requirements

In Georgia, projects requiring ecological examination are mainly regulated by the following laws:

Law of Georgia on Environmental Impact Permit

The law gives a complete list of activities subject to ecological examination. The body authorized for execution of ecological examinations is the Ministry of Environment Protection (MOE), which issues the permit after review of the documents and application presented by a project owner. If an activity listed in the law requires a Construction Permit, the permitting administrative body (or the Ministry of Economy and Sustainable Development) ensures the involvement of the MOE in the process so that ecological expertise is included in the review.

Law of Georgia on Ecological Examination

This law makes ecological examination an obligatory step to issue the environmental impact permit or construction permit for certain types of activities. The objective of an ecological assessment is to preserve an ecological balance by considering environmental requirements, sound use of natural resources, and sustainable development principles. A positive conclusion of the ecological examination carried out by the experts committee created by the MOE is necessary to obtain an environmental or construction permit.

Law of Georgia on Licenses and Permits

The law regulates the issuance of licenses or permits, gives an exhaustive list of licenses and permits, and sets the rules for issuing, amending, and cancelling permits. The law defines three principles for issuance of the license:

- "One-window" principle – meaning that a licensing administrative body shall ensure the approval of additional licensing conditions by the other administrative bodies.
- "Silence gives consent" – licensing administrative body is obliged to make a decision in due course after the submission of the application. Otherwise, if a decision is not made in the determined time period the license is deemed issued.
- "Umbrella principle" – the holder of the general license is not obliged to apply for specialized licenses.

Environmental Impact Permits are issued by the Ministry of Environment under a procedure involving (1) EIA, (2) ecological expertise, and (3) public participation. The detailed procedures are mainly determined by the Law on Environmental Impact Permit (December 14, 2007), the Law on Licenses and Permits (June 25, 2004) and the Decree No 154 "On the Procedure and Terms for Issuance of an Environmental Permit" Sept 2005 amended February 3, 2006.

The Law on Environmental Impact Permit contains the list of activities subject to EIA and the related procedures and regulations governing the issuance of environmental impact permits (EIP). The irrigation rehabilitation project does not require an EIP and/or State Ecological Expertise (SEE) under the Georgian legislation, since in accordance with the Article 4 of the Law of Georgia on Environmental Impact Permits, irrigation is not listed as a type of project subjected to EIP or SEE. Setting norms for maximum permissible levels of air and water emissions specifically for the project is not required either. According to current legislation, water and air emissions during rehabilitation and operation of the project facilities should therefore comply with the existing norms established by the Technical Regulations of the

Environmental Protection (Order of the Minister of Environment Protection No. 745, dated 13.11.2008).

NB: Recent changes introduced into the legislation (Law on Governance, March, 2011) concerning the environment protection and natural resources had significant impact on redistribution of governmental functions, transferring many responsibilities from the Ministry of Environment towards the Ministry of Energy and Natural Resources (forestry, inspectorates, natural resources use including fisheries and game), Ministry of Economy and Sustainable Development (licensing), Ministry of Regional Development and Infrastructure (regulation and investment in river bank protection and hydrological infrastructure), Ministry of Agriculture (regulating pesticides and fertilizers).

5. Environmental Consequences

To gather the additional information for this section, as stated in the Irrigation Environmental Scoping Statement (additional tasks/information requirements), GMIP held consultations with experts and hired a local biologist (to conduct an assessment of the ecological resources that may be found in the Affected Area; the resources that may be affected by the project; and possible mitigation measures to protect resources of concern. The EA Team also visited the areas that will be rehabilitated.

5.1 Environmental Impacts of the Proposed Action and Alternatives

The ESS provided an analytical framework for the EA phase that listed all environmental and social concerns gathered from documents, meetings, and field visits; identified the potentially significant concerns to be evaluated in the EA; developed issue statements for each; and identified the information and analysis needs that the Team would respond to during the EA phase. This chapter analyzes the significant issues identified by the Scoping Team. The EA Team made changes to the list of potentially significant issues, as described below.

5.1.1 Direct and Indirect Effects and their Significance

Table 5.1 shows the potential significant issues identified during the scoping process. Through additional consultations and site visits during EA preparation, the EA Team confirmed the potential significant impacts. The PEA Team also confirmed the Scoping Team's findings of issues considered not significant and therefore, further analysis would not be provided in the EA for those concerns.

Table 5.1: Potentially Significant Impacts for Tiriponi and Saltvisi Irrigation Schemes

Potentially Significant Impacts
1) Rehabilitation, including construction and operation phases, could impact TES and their habitat and could also affect other species of concern. This could occur through direct impacts (workers may over-fish or hunt without oversight) or it may occur indirectly through habitat alterations due to irrigation and agricultural production. Short and long -term impacts are possible.
2) Rehabilitation, including construction and operation phases, could impact wetlands and other habitats. There may be direct and indirect impacts (withdrawing water may reduce and dry up riparian habitat –direct; and irrigation may encourage conversion of natural areas to agriculture-indirect). Short and long-term impacts are possible.
3) During the construction phase, cultural resources may be found, disturbed, and/or destroyed.
4) With increased water available, agricultural production may expand into areas of ecological importance and result in conversion and fragmentation of habitat during operation phase of this project. Impacts are likely to become apparent over the long-term during the operation phase.
5) Irrigation water may carry contaminants downstream to areas where they may concentrate (if flushing is in adequate) and/or to areas where they may cause significant damage to land, crops, and other natural resources, and if they enter groundwater or surface water points, may threaten drinking water quality. This is mainly a long-term impact that is of concern during the operation phase.
6) Irrigation water can carry waterborne diseases that could affect humans, livestock, and crops. This is a concern during the operation phase, and may be a short (problems may arise immediately) and long-term impact (health problems may arise any time over the operation phase).
7) Discharge water from irrigated fields may be warmer than receiving water and could affect fish and bird populations. This is a concern during the operation phase and may be a short or long-term impact.
8) Cumulative impacts may result from the combination of past, present, proposed, and reasonably foreseeable actions. A cumulative effects analysis is part of all EAs.

9) Rehabilitation of irrigation schemes may fuel land and water conflicts and may make other underlying socio-economic issues more apparent. This is a concern during the operation phase and a potential long-term impact.
10) Water withdrawals for irrigation and sedimentation from operation of the irrigation scheme may affect fish migrations.
11) Irrigation may result in unsustainable water withdrawal that results in alterations to watershed hydrology. This impact is long-term and a concern during operation.

Below, each of the potentially significant issues from Table 5.1 is evaluated to determine the short, long, direct, and indirect social and environmental impacts of the alternatives. The significance of each potential impact is noted, along with the need for mitigation. Seven proposed mitigations are described in Section 5.4.

(1) Rehabilitation, including construction and operation phases, could impact threatened or endangered species and/or their habitat and could also affect other species of concern. This could occur through direct impacts (workers may over-fish or hunt without oversight) or it may occur indirectly through habitat alterations due to irrigation and agricultural production. Short and long -term impacts are possible.

During the EA phase, the EA Team held consultations to determine whether threatened, endangered, or otherwise protected species were present in the "Affected Environment," i.e., in or near the irrigation canals that will be rehabilitated and on the agricultural lands that will be irrigated by the scheme, as well as in the source waters. Also, as mentioned, GMIP utilized a biologist who visited the site; the biologist's expertise includes knowledge of fish and wildlife in the vicinity of the irrigation scheme rehabilitation. The information below is from EA phase consultations and field visits. It is based on the Affected Environment discussion in Section 4.

While abandoned agricultural fields can recover biodiversity value, the fauna at the Tiriponi and Saltvisi Irrigation Systems Project Area is strongly degraded from long use for agriculture, use of irrigation, and because of the dense human population. Under the No Action Alternative, the area is expected to transform to more shrub/brush and less cultivated land. This could favor certain species, including species of concern, as described below. Also, in the No Action Alternative, concrete lining would be expected to continue to deteriorate, resulting in obstructions to flow, and increased erosion and sedimentation of canals and downstream receiving water. Alternatives 1 and 2 may result in decreased erosion and sedimentation and improved water flow, while the No Action Alternative may provide slightly more natural bank habitat than Alternatives 1 and 2.

Below, TES and other species of concern that may be found in the Project Area (this term is used interchangeably with *impact area, affected area,* and *affected environment*) are noted, and potential impacts of the three alternatives on TES and other species of concern are discussed.

***Reptiles*.** Of the 12 to 14 reptile species that may be found within the Project Area, most are unlikely to be affected by construction or operation because they mainly use uplands and may use project lands only intermittently; and/or they are able to move to uplands if disturbed. However, there are exceptions.

The Mediterranean tortoise, which is on the Red Data List of Georgia, may occur in the impact area. The tortoise lays eggs on the banks of channels. Almost all of the irrigation channels are lined with concrete, and because the concrete has deteriorated, there may be some channel banks where tortoises can lay eggs. Under the No Action Alternative, concrete would continue to deteriorate, leaving more natural bank over time; natural bank areas would provide habitat for egg laying—a positive effect of the No Action Alternative. Alternatives 1 and 2 (respectively, proposed action using Mtkvari-M and proposed action with Water User Associations) would line most channel banks with concrete, and thus would diminish habitat for egg laying. Impacts on egg laying habitat of the Mediterranean tortoise of Alternatives 1 and 2 are long-term and irreversible. Alternatives 1 and 2 would require mitigations for these potentially significant impacts. (See below, Section 5.4, paragraph 1.)

The European marsh turtle (*Emys orbicularis*) can form large aggregations in stagnant and slow moving waters; destroying such habitats could lead to high mortality. Stagnant and shallow water would be more common under the No Action Alternative since concrete obstructions and sediment have slowed water flow, and this situation would continue without the project (No Action). In Alternatives 1 and 2, there would be improved water flow through the canals once obstructions are removed and construction is completed. This might decrease the habitat for the European marsh turtle. For Alternatives 1 and 2, depending on time of year and water use, there may be shallow water available for European marsh turtles; but for most of the year, water flow through the canal network would be improved (not stagnant), and not as favorable for the European marsh turtle as the No Action Alternative. Mitigation is needed for Alternatives 1 and 2 to minimize potentially significant impacts. (See below, Section 5.4, paragraph 2.)

Among reptiles that may occur in the Affected Area is one regional endemic of the Caucasus – the Kura lizard (*Darevskia portschinskii)*. Generally, rock lizards are highly dependent on specific rocks that are rich with insects. They often congregate in large numbers at a few sites, often at a distance from one another. Damage to one of these sites could impact the population or even threaten some rock lizard species in Georgia. Under the No Action Alternative, since there would be no construction, rocks would remain. Under Alternatives 1 and 2, damage to these rock habitats is unlikely and thus impacts to rock lizards are highly unlikely under either alternative.

***Amphibians*.** Six amphibian species may be found in the region. Of the two amphibian species on the Red List of Georgia, neither occurs in the Project Area. One species endemic to the Caucasus, the Caucasian toad (*Bufo verrucosissimus*), occurs along the main channels on the northernmost part of the Project Area. Ponds and streams are the critical habitat for this species during the breeding season early in spring. Ponds and streams in the Impact Area would not be directly affected by irrigation rehabilitation or operation under Alternatives 1 and 2 (indirectly, they may be contaminated during construction and operation, see impact #5 below). Under the No Action Alternative, ponds and streams may be affected because they may be used for irrigation water; ponds may be drained, and streams may be diverted or pumped to provide water for crops. Under Alternatives 1 and 2, this would be less likely since the irrigation network would again be functioning, decreasing the need to drain ponds and use stream water. Impacts to amphibians are not expected to be significant under either Alternative 1 or 2.

***Birds*.** Twelve bird species out of 35 on the Red List of Georgia may occur in the Project Area. For migratory birds, the Mtkvari valley between Tbilisi and Khashuri and the Liakhvi valley (both Didi and Patara) are important since the valleys are the migration path, while the rivers and floodplains provide shelter and feeding areas for waterfowl and waders. The entire area is an important stop-over site for migratory birds, and it is widely used by soaring birds.

Under Alternatives 1 and 2, construction and operation could affect resident and migratory species by affecting their habitat, including destruction of nesting places. During construction and maintenance (Alternatives 1 and 2, including canal and access road rehabilitation), if raptors (Falconiformes) are nesting on trees designated for cutting, raptor populations could be adversely affected. The No Action Alternative would mean that nesting trees remain in place.

Cutting brush/shrub areas during construction, operation, and maintenance (Alternatives 1 and 2) could affect birds that use that habitat for nesting, hiding, or feeding. Clearing of brush/shrub vegetation for crop cultivation might reduce habitat and could have a slight impact on bird populations. Clearing is more likely under Alternatives 1 and 2 since there will be irrigation water available and water will no longer be a limiting factor for cultivation. Under the No Action Alternative, the area is expected to transform to more brush/shrub and less cultivated land. This would have a beneficial effect on birds that use brush/shrub habitat.

Any changes in floodplain area and natural floodplain vegetation could affect birds that rely on these areas; this could result under Alternatives 1 and 2 indirectly if natural floodplain vegetation is converted to cultivated crops, which may be more likely if irrigation water is available. Under the No Action Alternative, few if any changes would be expected in floodplain vegetation; if agricultural land is abandoned, some agricultural areas could return to natural floodplain vegetation. Thereby, the No Action Alternative could have a positive effect on bird populations that rely on floodplain vegetation.

Alternatives 1 and 2 would require implementation of mitigation measures to minimize potentially significant impacts to birds. (See below, Section 5.4, paragraph 3.)

***Fish*.** Three fish species included in the Red Data List of Georgia (golden spined loach *Sabanejewia aurata,* brook trout *Salmo fario* and Kura undermouth *Chondrostoma cyri*) may occur in the Project Area. Spawning sites of these fish may be affected by diversion dams or by an increase in water turbidity and sediment load or by direct destruction of spawning sites in rivers used to supply irrigation water; this could be expected to occur during the construction phases for Alternatives 1 and 2. The No Action Alternative may also affect spawning sites since the deteriorating concrete and lack of erosion control also causes sedimentation. After construction is complete, fish bypasses are expected to be constructed at headworks and diversions, minimizing impacts to fish and their movement to spawing areas. Also, impacts associated with erosion and sedimentation may actually decrease (Alternatives 1 and 2) as compared to the No Action Alternative. Erosion control during construction would minimize concerns of Alternatives 1 and 2, and the operation and maintenance phase (Alternatives 1 and 2) would result in an improved situation for fish spawning areas.

The source rivers that feed the irrigation network may contain important commercial fish species as well as protected fish species. Currently, due to the deteriorated infrastructure, fish can get into the irrigation canals where they may be unable to escape. Under the No Action Alternative, this situation would continue. Under Alternatives 1 and 2, commercial and protected fish may also enter the irrigation canals. However, with the improved irrigation infrastructure expected to be in place, as planned in Alternatives 1 and 2, fish should not enter the irrigation network. The GMIP intervention is expected to use screening, possibly the Tyrol type rotating strip screens.

Alternatives 1 and 2 would require implementation of mitigation measures (fish bypasses, irrigation channel screening, sedimentation traps and erosion control) to minimize potentially significant impacts to fish and their spawning areas. (See below, Section 5.4, paragraph 4.)

Invertebrates. Of the 44 invertebrates on the Red Data List of Georgia, six species may occur in the Project Area. These include three butterflies, one bumblebee, one carpenter-bee, and one dragonfly. It is unlikely that rehabilitation of the irrigation system (Alternatives 1 and 2) will harm these species on a population level. Impacts are expected to be minor and approximately equal under all three alternatives.

Mammals. Up to five mammal species included in the Red List of Georgia (Table 4.10) are expected to occur in the Project Area. According to locals, the brown bear (*Ursus arctos*) penetrates into the Project Area in winter from neighboring forests to the north of the main channels of the Tiriponi and Saltvisi irrigation systems. But since the brown bear has such a large home range, and only uses the Project Area intermittently (since it has been under agriculture for such a long period, the bear mostly avoids the area), it is unlikely to be affected. Impacts are the same under the No Action Alternative as they are under Alternatives 1 and 2; although in the very long-term, under the No Action Alternative, the area could revert back to ecosystem types and low human density that the bear would prefer.

Geoffroy's bat (*Myotis emarginatus*), because it is not solely reliant on the irrigated area/Affected Environment, and because it does not use tree hollows, but instead, lives in buildings (mainly abandoned ones), will be not affected by Alternatives 1 and 2; impacts under all three alternatives are expected to be minor and equal. However, bats that use tree hollows (see Table 4.10) may be affected by Alternatives 1 and 2 in the construction phase (of canals and access roads) or operation and maintenance activities (if mature trees will be removed that serve as habitat for bats). Bats are protected under EUROBATS, and mitigation is needed for Alternatives 1 and 2 to ensure conservation of bats and their habitat. (See below, Section 5.4, paragraph 5.)

The common otter (*Lutra lutra*) may be affected during the construction phase in Alternatives 1 and 2. They are found in rivers, and construction at river crossings is a particular concern. Mitigation is needed during the construction phase of Alternatives 1 and 2 to minimize concerns. (See below, Section 5.4, paragraph 4.)

Brandt's hamster (*Mesocricetus brandti*) and the gray dwarf hamster (*Cricetulus migratorius*) may also be affected mainly during the operation phase of Alternatives 1 and 2. Compared with the No Action Alternative, where irrigation networks are in disrepair, hamsters are able to cross

to both sides of the channels, and there is some gene exchange, under Alternatives 1 and 2, populations may be cut off from each other. In the long-term under Alternatives 1 and 2, the lack of gene exchange could affect population viability of these hamster species. Mitigation is needed in Alternatives 1 and 2 to minimize concerns and protect Red-listed species. (See below, Section 5.4, paragraph 5.)

Endemics. Nine vertebrate species, endemic to the Caucasus, are found in the Project Area. Of possible concern are the species that are ranked "middle" for the potential of being affected by the proposed action. The Caucasian toad was discussed above. The other endemics ranked "middle" are the Caucasian mole, Robert's vole, and Brandt's hamster (discussed above). The shrew and the vole are found in forests, which are not expected to be affected by Alternatives 1 or 2.

Protected Areas. As shown in Figure 4.2, there are no protected areas, including national parks and protected forests, in the vicinity of the Affected Environment. Therefore, impacts on Protected Areas of all three alternatives are expected to be equal and minimal.

Significance: In accordance with USAID's Environmental Procedures (22 CFR 216.5), USAID is required to conduct its assistance programs in a manner that is sensitive to the protection of endangered or threatened species and their critical habitats. If a TES may be jeopardized or if critical habitat may be adversely affected by a USAID action, alternatives must be discussed (as in this EA) and modifications must be implemented to avoid or otherwise minimize the impacts (see Section 6). Potential impacts to certain species and their habitat may be significant and would require mitigations as described in Section 5.4 and in more detail in the EMMPs in Section 6.

(2) Rehabilitation, including construction and operation phases, could impact wetlands and other habitats. There may be direct and indirect impacts (withdrawing water may reduce and dry up riparian habitat –direct; and irrigation may encourage conversion of natural areas to agriculture-indirect). Short and long-term impacts are possible.

Major ecosystems in the Affected Area that may be impacted by the proposed rehabilitation are discussed in Section 4. Briefly, the ecosystems that may be affected by the alternatives and the mode of impact are described below.

- **Edge habitat.** Under Alternatives 1 and 2, there is more likelihood of conversion of natural areas to cultivated areas. Edge habitat is usually fairly high in species diversity. As agriculture spreads into natural areas, edge habitat may remain the same, but the inner habitat will be fragmented and total area of natural habitat would be decreased if under Alternatives 1 and 2 farmers convert land to cultivation. Under the No Action Alternative, edge habitat may decrease as well since cultivated land would return to brush/shrub and even to forest—this would decrease edge habitat. (A variety of habitats is needed to produce the edge effect.) There would be less chance for fragmentation, but edge habitat may be affected under the No Action Alternative as well as under Alternatives 1 and 2. A large expanse of brush/shrub with little edge effect is less valuable habitat in most cases

than a patchwork of habitat with considerable edge effect. See Impact No. 4 for an evaluation of the impact of habitat conversion.

- **Wetlands and wet meadows/floodplains.** Despite the manmade nature of the existing wetlands (from discharged irrigation water and from damaged canals), they can still provide shelter, feeding areas, and stopover sites during migration and wintering areas for many animal species. Alternatives 1 and 2, as mentioned above, may result in the conversion of natural floodplain to cultivated land; the No Action Alternative could have a positive effect on floodplain, since it may result in abandonment of agricultural land which could return to natural floodplain vegetation. Under Alternatives 1 and 2, farmers may expand the land they cultivate, which could decrease the extent of wetlands. See Impact No. 4 for evaluation of impacts and mitigations.

- **Hills and foothills occupied by xerophytic shrubbery** are found in minor areas near Gori. Under Alternatives 1 and 2, adverse impacts on these ecosystems might occur if large areas of brush/shrub will be cleared during construction and operation/maintenance, including clearing for cultivated crops. Mitigation (best practices) during construction is needed to minimize brush cutting.

- **Freshwater ecosystems**. The rivers in the Project Area are important for a range of species and reasons (as described above and in Section 4). In Alternatives 1 and 2, contamination could occur during construction (oil leaks) and operation (agricultural chemicals) and increased turbidity could occur during the construction phase (inadequate erosion control). However, as mentioned above, erosion and sedimentation would decrease during the operation phase of Alternatives 1 and 2 as compared to the No Action Alternative. In addition, the No Action Alternative could have a detrimental effect on ponds and streams, as mentioned above, since these may be pumped or diverted to provide irrigation water. Mitigations including fish bypasses and irrigation channel screens (See above, Impact No. 1) and best practices for construction (See EMMPs in Section 6) provide protection for freshwater ecosystems.

- **Riverbank ecosystems** may be affected under Alternatives 1 and 2 where head works are installed – on Didi Liakhvi and on Patara Liakhvi rivers; the affected area would be limited, and the environmental impacts would likely be minor. Under the No Action Alternative there would be no effect on riverbank ecosystems. Specifically, riverbank ecosystems are a concern for the Mediterranean tortoise, and mitigation is already proposed to protect this species and the riverbank ecosystem it relies on. This Mitigation would also be expected to protect other species that rely on riverbank ecosystems.

Significance: Potential impacts to ecosystems, in particular, wetlands, floodplain vegetation, brush/shrub, and edge habitat could result from Alternatives 1 and 2 as part of construction and operation. Construction phase best practices are included in EMMPs (See Section 6); Impact No. 4 discusses potential impacts to ecosystems during the operation phase (related to habitat conversion.)

(3) During the construction phase, cultural resources may be found, disturbed, and/or destroyed.

During the EA phase, the EA Team found that the Nikozi Cathedral Ensemble is located in what is considered the Affected Environment, and that it had previously been damaged from irrigation waters. In addition, the EA Team was told that smaller sites may once have been located in the Project Area; and chance finds of cultural resources are possible. Alternatives 1 and 2 could disturb these resources, in particular during rehabilitation of the channels and headworks. The No Action Alternative could have an adverse effect, in particular, on the Nikozi Cathedral Ensemble, as it has in the past. This could be significant and there would be no resources to mitigate impacts under the No Action Alternative. Whereas, the rehabilitation planned under Alternatives 1 and 2 is expected to minimize the potential for future adverse impact on the Nikozi Cathedral Ensemble.

Significance: Potential impacts to cultural/historical resources are more significant under the No Action Alternative (the Cathedral Ensemble). Alternatives 1 and 2 could have a positive effect on the Cathedral Ensemble. However, best practices (safeguards) are needed during the construction phase (Alternatives 1 or 2) to ensure that chance finds are not damaged. (See below, Section 5.4, paragraph 6.) The construction phase mitigations are also used to prepare a report with mitigation measures for use during the irrigation operational period. (See Section 6.)

(4) With increased water available, agricultural production may expand into areas of ecological importance and result in conversion and fragmentation of habitat during the operation phase. Impacts are likely to become apparent over the long-term.

Impacts on ecosystems were discussed under Impact No. 2 above and under Impact No. 1 with a focus on TES and other protected species and their habitat. This impact discussion below specifically applies to farmers and decisions they make about what to do with their land. Since an improved irrigation network will mean that water availability may not be a limiting factor in decisions to cultivate, farmers may decide to clear natural vegetation to plant crops.

As discussed in (1) and (2) above, certain ecosystem types and habitats are of particular importance for wildlife, and if converted, would have adverse effects. Wetlands, even manmade, are important for wildlife, including migratory and resident birds. Snags in mature trees provide habitat for bats and birds. Floodplain vegetation is important for aquatic mammals, some species of birds, and amphibians. Brush/shrub is used by many species of birds for feeding, nesting, and as protection. These types of habitats may be in private ownership, although they are likely to be fragmented and degraded. With ownership now in private hands, it is difficult to control what farmers do with their property. In addition, most of the private lands currently in use and even lands not in active use have already been converted to cultivated land.

As described above, for Alternatives 1 and 2, brush/shrub and riparian/floodplain ecosystems may be affected if they are cleared for crop production, and wetlands may be drained to create cultivable land. Under the No Action Alternative, brush/shrub land is expected to increase, and floodplain vegetation may also increase. However, wetlands and streams may be drained to

provide water for crops. Under the No Action Alternative, there would be no possibility to mitigate the situation.

With the modernization of agriculture and with GMIP coordination with USAID's EPI and NEO projects, it is likely that farmers will be using improved production practices, which include better use of fertilizers and soil conservation measures. These measures would focus on improving productivity rather than expanding land under agriculture. These projects are expected to help reduce impacts associated involving habitat conversion.

However, there may be specific situations where wildlife of concern and their habitat exist (as discussed under Impact No. 1 above) on private land. The discussion in (1) above and the mitigation measures also described would be applicable for private or community-owned/open access lands—for TES and other protected species---regardless of the ownership of the land.

Under Alternative 1 (which includes Mtkvari-M as the managing entity of the irrigation network), GMIP would likely be better able to implement and oversee safeguards since Mtkvari-M has access to a range of expertise and would not be beholden to a membership made up of other community members. Alternative 2 (which relies on Water User Associations as the managing entity) would be less likely to have the expertise to implement safeguards, and WUAs may be reluctant to require their own members to implement mitigation.

Significance: For Alternatives 1 and 2, this is significant in that TES and other protected species and their habitat may be affected by farmers' decisions to convert land to agriculture (based on water availability due to the rehabilitated irrigation schemes), and mitigation would be needed specifically to address these concerns. Implementation of mitigation and monitoring may be more effective under Alternative 1.

(5) Irrigation water may carry contaminants downstream to areas where they may concentrate (if flushing is inadequate) and/or to areas where they may cause significant damage to land, crops, and other natural resources, and if they enter groundwater or surface water points, may threaten drinking water quality. This is mainly a long-term impact that is of concern during the operation phase.

As agriculture modernizes—as a connected action to irrigation rehabilitation (USAID interventions, as well as other bilateral/multilateral support programs) ---more pesticides and chemical fertilizers may be used. However, modernizing agriculture will also encompass conservation measures and integrated pest management (IPM). While USAID requires strict oversight of pesticide use, and strongly encourages IPM and the use of low toxicity pesticides, not all donors and partners will have such strict safeguards and oversight.

Regardless, highly toxic pesticides are available in Georgia (as is indicated in USAID/Georgia PERSUAPs) and GMIP and other USAID/Georgia projects have limited control over what farmers actually use; this will especially be true in the long-term. For crops that will be exported to EU countries, strict pesticide limits may discourage unsafe use and use of highly toxic pesticides. But for crops grown for subsistence, there are no such requirements.

Under the No Action Alternative pesticides and chemical fertilizers may be used, and equally under Alternatives 1 and 2, agricultural chemicals may be used. Agricultural chemicals, especially if they are used unsafely, can be carried back to river water or may enter groundwater. This would be the case with or without rehabilitated irrigation systems—pesticides can enter water (surface and/or ground water) and can enter the food chain in various ways, and affect humans, fish, and wildlife. The key is to control the toxicity of pesticides and the over-use of chemical fertilizers, and to train extension officers and farmers. However, this is beyond the current irrigation rehabilitation intervention. (USAID's agricultural production projects are assisting with training in IPM and safe use of pesticides; and it is also the responsibility of the GoG and other donors to play roles in this area).

Significance: This potential impact is the same under the No Action Alternative and Alternatives 1 and 2, and is beyond the scope of GMIP. No mitigation is recommended.

(6) Irrigation water can carry waterborne diseases that could affect humans, livestock, and crops. This is a concern during the operation phase, and may be a short-term impact (problems may arise immediately) and long-term impact (health problems may arise any time over the operation phase).

The EA Team conducted additional research on this issue, including consulting experts on waterborne diseases. There is consensus that this issue does not have a high probability of occurrence, and is not a significant potential environmental concern.

It is unlikely that sewage would be discharged to irrigation waters. The irrigation canals and sewage disposal systems are separate systems. However, if someone along the canal were to discharge sewage to the irrigation canal, this could occur under the No Action Alternative or under Alternative 1 or 2. It is unlikely under all alternatives. In fact, under Alternatives 1 and 2, it is less likely that sewage water would be used to irrigate crops (since irrigation water will be available), and therefore, less likely that humans and livestock would eat food grown that was watered with sewage water, and therefore, less likely to get bacterial or viral infections.

Significance: Impacts are highly unlikely to result under all Alternatives. Based on the additional information gathered during the EA phase, the EA Team determined that this issue is not significant and no mitigation is needed.

(7) Discharge water from irrigated fields may be warmer than receiving water and could affect fish and bird populations. This is a concern during the operation phase and may be a short or long-term impact.

During the EA phase, the EA Team researched this issue further and spoke with a fisheries expert to determine the significance of this issue. The difference in temperature from the water in the irrigation canals and in the source waters would not be expected to vary enough to affect fish. Fish species that are abundant in Georgia are usually tolerant of slightly warmer waters and are tolerant of a range of temperature. However, the difference in temperature is expected to be so minimal that it is unlikely to make any difference to fish populations.

Significance: Based on additional information gathered during the EA phase, the EA Team determined that this issue is not significant and no mitigation is needed.

(8) Cumulative impacts may result from the combination of past, present, proposed, and reasonably foreseeable actions.

A cumulative effects analysis is part of all EAs. (See below, Section 5.1.3.)

(9) Rehabilitation of irrigation schemes may fuel land and water conflicts and may make other underlying socio-economic issues more apparent. This is a concern during the operation phase and a potential long-term impact.

Under Alternatives 1 and 2, conflicts over land and water access rights may be inflamed once irrigation rehabilitation is completed. However, both alternatives could also have a positive effect because they will provide greater availability and access to irrigation water, and this would help minimize conflicts. During the operation phase of both alternatives, if distribution is seen as inequitable, new conflicts could arise—and just as with any resource that is viewed as a public good, it is likely that there will be some conflict over distribution, not all will be severe or long lasting. Alternative 1, with Mtkvari-M as the management entity, may be better placed to resolve conflicts because the company could act as an arbiter of conflicts and would not be seen to have an interest in the outcome. Under Alternative 2, with a Water User Association made up of community members, members may be more likely to act out of self-interest or based on family or other ties.

Under the No Action Alternative, irrigation water would continue to be limited, and the current situation--where conflicts over water occur regularly--would be expected to continue.

Other conflicts could also occur under Alternatives 1 and 2 because users will be required to pay for irrigation water and for maintenance costs. Again, the private enterprise, Mtkvari-M, would be more likely to fairly resolve conflicts over payment of fees than a Water Users' Association, which may act in the interest of friends and family. Under the No Action Alternative, these conflicts would not occur since there would be no fee for services.

Significance: Conflicts could derail the management of the irrigation systems, and under Alternatives 1 and 2, the management entity will need to have the skills to be able to resolve conflicts and to transparently account for finances; this should minimize fuel for conflicts. The Section 6 mitigations will address strengthening Mtkvari-M's skills in conflict resolution.

(10) Water withdrawals for irrigation and sedimentation from operation of the irrigation schemes may affect fish migrations.

As discussed above, under the No Action Alternative, erosion and sedimentation are more likely to occur and to cause significant problems than under the other alternatives. Alternatives 1 and 2 will stabilize the banks, decreasing erosion and sedimentation during operation; and sediment traps will be installed in Alternatives 1 and 2, decreasing sedimentation. The maintenance phase

of Alternatives 1 and 2 includes regular cleaning. During the construction phase of Alternatives 1 and 2, if proper erosion control is in place, erosion would not be a serious concern.

Under Alternatives 1 and 2, during the operation phase, water withdrawals from source rivers to the irrigation network could affect flow in the river, and thereby affect fish movement. Water withdrawal under all alternatives is a significant potential impact, and only in Alternatives 1 and 2 is there a possibility to mitigate this. As above, under Alternative 2, it may be more difficult to fairly distribute and ration water when necessary because members of the WUA may favor certain farmers. Alternative 1 with Mtkvari-M as the management entity may be better placed to distribute water fairly and to ensure that downstream users, including ecosystems, are not affected by irrigation water withdrawals.

Significance: This is a potentially significant impact of all three alternatives. Under Alternatives 1 and 2, mitigation can be applied, and under Alternative 1, mitigation (water allocation to farmers so that it does not affect downstream uses) may be more fairly and transparently applied. (See below, Section 5.4, paragraph 7.)

(11) Irrigation may result in unsustainable water withdrawal that results in alterations to watershed hydrology. This impact is long-term and a concern during operation.

Currently (the No Action Alternative), there are many leaks and a large proportion of water that flows through the network is lost. Under Alternatives 1 and 2, water wastage and loss would be minimized—the leaks would be repaired. Even though water flow through the irrigation network would increase under Alternatives 1 and 2, management entities such as Mtkvari-M will be in place to monitor water withdrawal. If short-term weather patterns change, or if long-term impacts that are expected under climate change materialize, there could be more demands for the limited water.

Water withdrawals under Alternatives 1 and 2 could affect watershed hydrology, especially if demand increases and water supply decreases. As above, Mtkvari-M may be able to regulate and allocate water more fairly and transparently than the WUA (in Alternative 2).

Significance: This could be a significant impact under all alternatives, but only under Alternatives 1 and 2 is mitigation possible. If water withdrawals are not monitored and allocated to adjust for other watershed purposes, water withdrawal could have an effect on ecosystems and the wildlife and humans that rely on these systems. The mitigation to collaborate with Mtkvari-M to develop a systemwide O&M management system is a key to ensuring sustainable water withdrawals and protection of watershed hydrology. (See below, Section 5.4, paragraph 7, and EMMPs in Section 6.)

In addition to the above, the Scoping Statement identifies some issues that require no further analysis in the EA yet mitigation (implementation of "best practices") is required to ensure that adverse impacts do not result. Table 5.2 describes the concerns that have been eliminated from further evaluation.

Table 5.2: Concerns that have been Eliminated from Further Evaluation (require best practices)

Concern
Grading, trenching, and excavation; offsite overburden and waste soil disposal; management of any contaminated spoil arising from the sites during construction needs careful, appropriate and well-defined planning and execution; disposal of excavated material; disposal of construction waste
Accidental drowning
Waterlogging and salinization of soils; land salinization and/or groundwater quality; excess irrigation and intensified agricultural production on irrigated lands can reduce soil fertility over time by making it more salty.
How will the increased sedimentation upstream affect irrigation intakes, pumps, filtration operations and in-field channels downstream? Vegetation growth and sedimentation in canals
For areas that have not had access to irrigation water how will the resulting saturated area affect runoff from irrigated croplands during a storm?
Inability to pay for water
Dust generation; pedestrian and traffic safety; health and safety
Increased erosion and sedimentation during operation
Rehabilitation activities could deplete air quality, cause noise pollution, and leaks from machinery could pollute water and soils.
Construction camps could result in pollution of surface and groundwater if inadequate sanitary facilities are not provided; cutting of trees if alternative fuel and building material is not provided; and could alter landscapes if the site is not returned to previous conditions.

5.1.2 Cumulative Effects and their Significance

Cumulative impact is defined by the United States Council on Environmental Quality as:

…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

The Tiriponi Valley is an agricultural valley and most of the past, present, and future actions are in line with the agricultural nature of the valley. There is very little development other than agricultural. GMIP and USAID's EPI and NEO projects will help agricultural production in the valley, possibly resulting in increased demand for irrigation water. However, these projects would also be expected to provide technical assistance on water conservation and improved on-farm water management and drainage.

Donor and GoG interventions are also expected to be mainly agricultural. The nature of the valley is expected to remain similar to what it is today—agricultural, but with a stronger secondary producer network. Farmers are expected to have improved links to markets, and these would likely be EU markets, which could encourage improved and safer use of pesticides and fertilizers, and better land management measures (as part of EurepGAP requirements).

Past experience indicates that with an improved irrigation rehabilitation network, unauthorized connections and cutting of new irrigation channels may occur. This is more likely to occur because of the planned interventions that will make agriculture more productive and lucrative. Alternatives 1 and 2 include an irrigation management entity that would oversee and control unauthorized usage.

5.1.3 Possible Conflicts between Proposed Action and Land Use

The Proposed Action is in line with current land use, which is mostly agricultural. As described in Section 4, the Tiriponi Valley is an agricultural area, and the land has been cultivated and irrigated for centuries. There is no conflict between the Proposed Action and the land use.

5.1.4 Possible Conflicts between Proposed Action and Policies and Controls

As described in Section 4, GMIP and MDA will ensure that the Proposed Action is not in conflict and is in compliance with local policies and controls. GMIP has been regularly coordinating with local authorities to ensure that the rehabilitation complies with local requirements such as zoning and water use, and other applicable regulations.

5.2 Energy Requirements of Alternatives

Alternatives 1 and 2 require pumping of river water into irrigation channels. The original irrigation systems were gravity-feed from headworks located on the Didi Liakhvi River at Tskhinvali. The head works is now in the occupied zone and flow to the two schemes was cut-off in 2008. GoG constructed a new diversion dam and pumping station at Kvemo Nikozi, several kilometers downstream of the old head works. The new pump station has six pumps and a seventh will begin operation in 2012. For the GMIP rehabilitation project, six pumps will serve Tiriponi and one will serve Saltvisi. The irrigation networks cannot operate without this pumping and its associated energy usage. Pumping may also be needed by the end-user to get the irrigation water to the crops. The need for energy is the same under Alternatives 1 and 2. There would be no additional energy requirement under the No Action Alternative.

5.3 Irreversible and Irretrievable Commitment of Resources

As described above, in Section 5, under the Proposed Action, concrete will be place on the banks of irrigation channels. Natural bank vegetation and the habitat it provides, especially for Mediterranean tortoise egg laying, may be lost. In addition, the rehabilitation may prevent hamster populations from mixing, which could have long-term effects on these populations. However, GMIP will implement all reasonable measures as advised by the biologist to be hired for the construction phase, and will take all efforts, as recommended, to minimize impacts.

5.4 Means to Mitigate Adverse Environmental Impacts

Mitigation is possible for all expected adverse impacts with the exception of impact 4 above—it is outside the scope of GMIP to ensure that land conversion to agriculture as a result of greater availability of irrigation water does not result.

Mitigation for construction phase impacts will ensure that construction camps do not have adverse effects on habitat, fish, and wildlife, land, and water resources. In addition, measures are available to mitigate potential impacts of construction phase activities to ensure that erosion and sedimentation is minimized; that the possibility of fuel and oil leakages are minimized and a contingency plan is in place if leaks occur; that construction at river crossings is performed with safeguards in place so that otter habitat is protected; and to ensure other construction phase impacts, as identified above are implemented and monitored. Mitigation measures, including best practices, will be included in the Bill of Quantities for the construction contractor and GMIP and MDA will monitor implementation of the measures.

In addition, mitigation is available to minimize all potentially significant impacts noted in Section 5:

(1) A biologist experienced with identification of the Mediterranean tortoise and knowledgeable about its habitat and egg laying will be subcontracted during the construction phase. Mitigations should cover surveys (including special surveys during egg laying times, and development and implementation of measures (including worker training) to protect the tortoises. A report should be prepared at the end of construction that covers the mitigations used to protect tortoises during the construction phase and that recommends mitigation measures for use during the irrigation operational phase.

(2) Monitoring, inspections and training aimed at the Mediterranean tortoise above should also minimize impacts to the habitat of the European marsh turtle.

(3) A biologist experienced with identification of Red List birds and knowledgeable about their habitats and nesting places will be subcontracted during the construction phase. Mitigations should cover surveys (including special surveys during nesting times, and development and implementation of measures (including worker training) to protect these birds. A report should be prepared at the end of construction that covers the mitigations used to protect birds during the construction phase and that recommends mitigation measures for use during the irrigation operational phase.

(4) A biologist experienced with identification of fish on the Red List and knowledgeable about their spawning areas will be subcontracted during the construction phase. Mitigations should include: fish bypasses at headworks and diversions; screens to keep fish out of irrigation channels; and sedimentation traps and erosion control to protect spawning areas. Mitigations are expected to minimize potentially significant impacts to fish and their spawning areas.

(5) Mitigations should cover surveys and development and implementation of measures (including worker training) to protect the mammals noted in Section 5.1 (bats, Brandt's hamster and dwarf gray hamsters, and the otter). Mitigations may include green bridges that allow small animals to cross irrigation channels and support gene exchange between subpopulations. A report should be prepared at the end of construction that covers the mitigations used to protect mammals of concern during the construction phase and that recommends mitigation measures for use during the irrigation operational phase.

(6) Best practices (delineated in the EMMPs) should be implemented during construction to ensure that cultural/historical resources are not affected and chance finds are not damaged. A report should be prepared at the end of the construction phase about the mitigation measures that were implemented and that recommends mitigation measures for use during the irrigation operational period to protect cultural and historic resources.

(7) The mitigation (See Section 6, Table 6.2) to collaborate with Mtkvari-M to develop a system-wide O&M management system is a key to ensuring sustainable water withdrawals and protection of watershed hydrology.

5.5 Summary

As discussed above and in Section 3.4, and as illustrated in Table 3.1, impacts of Alternatives 1 and 2 are equivalent during construction. During operation and maintenance, Alternative 1 (Mtkvari-M) is expected to perform better—Mtkvari-M is expected to have more environmental benefits than a WUA.

The No Action Alternative would avoid the construction impacts of Alternatives 1 and 2, but most of these are easily mitigated. The No Action Alternative fails to change the situation regarding water wastage and loss; and erosion and sedimentation will continue to diminish the quality of the irrigation channel water, and the habitat for fish and other aquatic vertebrates and invertebrates. Also, the No Action Alternative does not address the ongoing conflicts over water or the ongoing damage to cultural resources (while the Proposed Action does address these).

The concerns regarding TES and habitat are equivalent under Alternatives 1 and 2, and mitigation is proposed (EMMP and above) that is expected to minimize concerns so that these potential impacts are no longer considered significant.

Long-term, cumulative impacts of possible conversion of natural habitats is a concern for Alternatives 1 and 2; however, as stated, there is very little natural habitat that is privately owned. Most was converted to agriculture hundreds of years ago. Other USAID projects are expected to provide technical assistance to farmers that would encourage intensification of agriculture rather than expansion into what little natural areas remain.

The predicted environmental impacts of the Proposed Action can be mitigated with the measures shown below in the EMMP, and their level of significance can be reduced to the point where no expected adverse effects are expected from the Proposed Action.

6. Environmental Mitigation and Monitoring Plans

This chapter includes the EMMP for irrigation rehabilitation activities. Table 6.1 covers both mitigation measures and monitoring and reporting.

6.1 Environmental Mitigation and Monitoring Plans

The Table 6.1 EMMP addresses impacts associated with construction activities, channel rehabilitation, disposal of channel spoil and sediment, damaged concrete, road improvements, socio-Economic and public health and safety. The EMMP addresses impacts to TES and cultural and historic resources. The Table 6.2 EMMP covers irrigation operation including soil impacts (e.g., waterlogging and salinization), water impacts, impacts to TES and cultural/historic resources and irrigation O&M systemwide management.

Tables 6.1 and 6.2 provide the monitoring indicator(s), monitoring and reporting frequency and GMIP party responsible for monitoring. Monitoring is provided to ensure the effectiveness of mitigation measures. For TES and cultural/historic impacts monitoring, a report is included at the end of the construction period that recommends mitigation measures for use during the irrigation operational period to protect TES and cultural and historic resources.

For the activity, Rehabilitation of Tiriponi and Saltvisi Irrigation Schemes, mitigations in Table 6.1 address the following identified environmental impacts:

- Impacts to Threatened, Endangered & Protected Species (TES) including: Mediterranean tortoise, European marsh turtle, Red List & migratory birds, Geoffroy's bat, common otter and Brandt's hamster and gray dwarf hamster.

- Impact to Threatened, Endangered & Protected Species (TES) fish including: Golden spined loach, brook trout and Kura undermouth. Protect Spawning Areas.

- Impacts to Cultural and Historic Resources including Nikozi Cathedral Ensemble and damage to cultural or historic chance finds.

- Construction Camp Damage to Local Habitats and Depletion of Local Fauna/Flora.

- Impacts from Lack of Environmentally Sound Facilities or Poor Sanitation at Construction Camp Facilities.

- Impacts from Lack of Management of Construction Areas, Equipment and Materials Storage.

- Community Impacts from Introduction of Alcohol and Other Socially Destructive Substances via Construction Crews.

- Impacts from Lack of Control of Stormwater runoff during Irrigation Rehabilitation.

- Impacts from Removal and Disposal of Irrigation Channel Spoil, Sediment, and Bushes/Trees.

- Impacts from Removal and Disposal of Damaged/Broken Concrete Panels and Slabs.

- Impacts from Channel Rehabilitation (Add Compacting Soil to Bottom of Channel or Construct Concrete Slabs/Panels).

- Impacts from Rehabilitation of Channel Crossings (Construct New Crossings if needed, Allow for Animal Crossing to Grazing Areas).

- Impacts from Access Road Improvements.

- Noise, Odor and Visual Quality Impacts.

- Socio-economic Impacts.

- Public Health and Safety Impacts.

For the activity, Operation of Tiriponi and Saltvisi Irrigation Schemes, mitigations in Table 6.2 address the following identified environmental impacts:

- Impacts to Threatened, Endangered & Protected Species (TES).

- Impacts to Cultural and Historic Resources.

- Soil Impacts including Waterlogged Soil and Salinization.

- Water Impacts including Poor Irrigation Methods, Water Quality and Water Quantity Problems for Downstream Users.

- Socio-economic Impacts.

- Public Health and Safety Impacts.

- Water, Soil and Other Environmental Impacts due to Weak Systemwide O&M Management System.

TABLE 6.1: Environmental Mitigation and Monitoring Plan for Irrigation Rehabilitation

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
1) Rehabilitation of Tirponi and Saltvisi Irrigation Schemes	Impact to Threatened, Endangered & Protected Species (TES) including: Mediterranean tortoise, European marsh turtle, Red List & migratory birds, Geoffroy's bat, common otter and Brandt's hamster and gray dwarf hamster.	Y	• Use biologist experienced with TES and their habitat identification & protection. • Survey irrigation areas for possible TES habitats. • Conduct additional survey during Mediterranean tortoise egg laying time and bird nesting times. • Develop TES program to protect TES habitats. • Develop special targeted mitigations to protect tortoise eggs/bird nesting, hamster gene exchange, and bat tree hollows. • Implement TES protection programs including worker training to identify and protect TES and habitats.	• Surveys by TES biologist. • Inspections by TES biologist. • Number of TES identified • Number of TES habitats protected • Number of harmed/dead TES in river and irrigation channels. • Number of special target mitigations. • Number of employees trained.	Survey reports for TES/habitat identification and protection Inspections monthly during construction TES protection report at end of construction, including mitigation measures for irrigation operational period.	Requirements specified in contracts Periodic inspections by MDF and GMIP
	Impacts to Threatened, Endangered & Protected Species (TES) fish including: Golden spined loach, brook trout and Kura undermouth. Protect spawning areas.	Y	• Use biologist experienced with TES fish species. • Design fish bypass in river to protect fish and travel to spawning sites. • Design screening, intake, settlement area, proper streambed alignment to keep fish out of irrigation channels.	• Inspection by TES biologist • Number of TES fish found in river. • Number of TES fish found in irrigation channels.	Inspection monthly during construction TES protection report at end of construction, including mitigation measures for	Requirements specified in contracts Periodic inspections by MDF and GMIP

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			• Protect construction site, provide natural barriers, sediment traps and erosion control. • Train workers and provide guidelines with how to identify and what to do if TES fish present.	• Number of harmed/dead fish in river and irrigation channels	irrigation operational period.	
	Impacts to Cultural and Historic Resources including Nikozi Cathedral Ensemble and Damage to Cultural or Historic Chance Finds.	N	• Use specialist who knows about cultural/historic sites • Protect Nikozi Cathedral Ensemble during construction including minimum site disturbance, natural barriers, limiting access and worker training • Worker training to identify and protect cultural or historic chance finds.. • Remove & dispose of sediments, spoils and damaged concrete to offsite disposal site that protects cultural and historic resource sites. • Revegetate to protect cultural/historic site. • Prevent erosion and changes to existing waterways	• Inspection by specialist who knows about cultural and historic sites. • Complaints by residents or members of cultural or historic site.	Inspection monthly during construction Cultural/historic sites protection report at end of construction, including mitigation measures for irrigation operational period.	Requirements specified in contracts Periodic inspections by MDF and GMIP
	Construction camp	N	• Analyze area for possible	• Camp	Monthly during	Requirements

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
	damage to local habitats and depletion of local fauna/flora		habitat or fauna/flora damage, select proper site for construction camp • Keep camp size to minimum • Explore off-site accommodation for crews • Provide adequate quantity of food and cooking fuels • Train workers to protect local habitat and local fauna/flora, create defined footpaths in/out of camps	Inspections • Complaints from nearby farmers or residents.	construction phase; once during demobilization	specified in contracts Inspections by MDF and GMIP.
	Impacts from lack of environmentally sound facilities or poor sanitation at construction camp facilities (Soil and Water Contamination)	N	• Provide sound temporary sanitation facilities (e.g., dry toilets or pit latrines, cleanup of food services, trash/waste collection bins • Provide off-site housing for workers • Use minimum camp size • Remove and restore site after construction is completed	• Camp inspections • Complaints from nearby farmers or residents.	Monthly during construction phase; once during demobilization	Requirements specified in contracts Inspections by MDF and GMIP.
	Impacts from lack of management of construction areas, equipment and materials storage areas (Soil and Water Contamination)	N	• Install fence and signs • Set protocols for storage of materials and wastes • Set protocols for equipment storage and maintenance • Limit onsite equipment maintenance, require most maintenance offsite	• Camp inspections • Complaints from nearby farmers or residents	Monthly during construction	Requirements specified in contracts Inspections by MDF and GMIP.

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			• Store fuels and lubricants in safe place, provide spill protection, emergency response procedures • Prevent dumping of hazardous materials • Prevent dumping of other non-construction waste • Remove and restore site after construction is completed			
	Community impacts from introduction of alcohol and other socially destructive substances via construction crews	N	• Prohibit alcohol and socially destructive substances in construction camps • Use local or regional labor if possible • Install signs and reminders that alcohol/substances are prohibited	• Camp inspections • Complaints from nearby farmers or residents	Monthly during construction	Requirements specified in contracts Inspections by MDF and GMIP
	Impacts from lack of control of stormwater runoff during irrigation rehabilitation	N	• Install stormwater control barriers (hay bales, filters) to prevent erosion • Restore site through replanting, reseeding and soil erosion measures (especially after old concrete panels and slabs removed)	• Camp inspections • Complaints from nearby farmers or residents	Monthly during construction	Requirements specified in contracts Inspections by MDF and GMIP
	Impacts from removal and disposal of irrigation channel spoil, sediment bushes/trees (Soil and	N	• Protect area next to channel burm. Use construction lines to mark construction zone.	• Monitor waste quantity (kg (m3)) • Inspection	Monthly during construction	Requirements specified in contracts

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
	Water Contamination)		• Minimize removal of brush/brush cutting. • Provide dust control during extraction and disposal of spoil and sediment. • Train workers to protect surrounding environment • Excavator/dragline used to remove materials onto cleared side of channel • Remove sediment under bridges by hand • Materials stored onsite, protected from stormwater runoff or wind until transport for spreading or beneficial use/disposal • Provide spoil/sediment to farmers for beneficial land application • Spread spoil/sediment as channel supporting berm if no farmers available • Prevent soil erosion • Use organic matter for channel protection	channels • Complaints from nearby farmers or residents		Inspections by MDF and GMIP.
	Impacts from removal and disposal of damaged/broke concrete panels and slabs (Soil and Water Contamination)	N	• Protect area next to channel berm. Use construction lines to mark construction zone. • Provide dust control during removal and	• Monitor amounts of Concrete waste (tons) • Inspection channels	Monthly during construction	Requirements specified in contracts Inspections by MDF and

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			disposal of old concrete panels and slabs. • Train workers to protect surrounding environment • Excavator used to remove concrete panels/slabs onto cleared side of channel • Minimize use of heavy machinery • Concrete stored onsite, protected until transport for disposal • Small tractors haul concrete to trucks • Prevent erosion • Remove concrete to areas needing berm support • Dispose in landfill if no alternate use available	• Complaints from nearby farmers or residents		GMIP
	Impacts from channel rehabilitation (Add compacting soil to bottom of channel or construct concrete slabs/panels).	N	• Protect area next to channel berm. Use construction lines to mark construction zone. • Train workers to protect surrounding environment • Minimize use of heavy machinery • Procure materials from licensed sources • Small tractors haul concrete or concrete slabs/panels to channel • Restore site through	• Inspection channels • Complaints from nearby farmers or residents.	Monthly during construction	Requirements specified in contracts Periodic inspections by MDF and GMIP

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			replanting, reseeding and soil erosion measures			
	Impacts from rehabilitation of channel crossings (construct new crossings if needed, allow for animal crossing to grazing areas).	N	• Identify locations for new crossings and crossings needing rehabilitation through discussions with local authorities and village leaders. • Construct crossing or rehabilitate existing crossings. • Protect areas near crossing construction, minimize use of heavy machinery. • Provide safety controls.	• Inspection of crossings • Complaints from nearby farmers or residents.	Monthly during construction	Requirements specified in contracts Periodic inspections by MDF and GMIP
	Impacts from access road improvements (Soil and Water Contamination)	N	• Protect areas next to access roads being repaired/graveled. • Prevent erosion and damage to existing irrigation channels. • Protect waterways in areas near access roads. • Minimize use of heavy machinery • Procure materials from licensed sources • Adhere to road design and engineering specs and follow best practices • Train workers to protect surrounding environment.	• Camp inspections • Complaints from nearby residents	Monthly during construction	Requirements specified in contracts Periodic inspections by MDF and GMIP
	Noise, Odor and Visual	N	• Schedule trucks carrying	• Visual	Monthly during	Requirements

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
	Quality Impacts		waste/building materials to minimize local impacts. • Minimize use of heavy equipment during early morning or nights	• Complaints from users and nearby residents.	construction	specified in contracts Periodic inspections by MDF and GMIP
	Socioeconomic Impacts	N	• Hire local workers. • Community public meetings to share mitigation information. • Protect local cultural and historic resources.	• Number of local workers • Number of public meetings.	One time during construction phase	Requirements specified in contracts Periodic inspections by MDF and GMIP
	Public Health and Safety Impacts	N	• Written safety procedures. • Provide workers with protective equipment (e.g., gloves, boots, eyewear). • Provide safety controls, handrail barriers, safety screens and signs. • Protect children and local communities from accidental drowning through use of signs, factsheets (See example, http://www.lni.wa.gov/Safety/Research/FACE/files/ag_drown.pdf, and educational materials for schools. • Manage construction traffic to protect children and the community.	• Inspections • Number of accidents and injuries. • Complaints from nearby residents	Quarterly	Requirements specified in contracts Periodic inspections by MDF and GMIP

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			• Signs clearly displayed • Protect public from stored waste/building materials or abandoned structures			

TABLE 6.2: Environmental Mitigation and Monitoring Plan for Irrigation Operation

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
2) Operation of Tirponi and Saltvisi Irrigation Schemes	Impacts to Threatened, Endangered & Protected Species (TES)	Y	• Implement mitigations in TES protection report prepared at end of construction period.	• Number of TES identified • Number of TES habitats protected • Number of special target mitigations. • Number of harmed/dead TES in river and irrigation channels	Before and After Irrigation Season. Monthly during Season	Requirements specified in contracts Periodic inspections by MDF

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
	Impacts to Cultural and Historic Resources .	N	• Implement mitigations in cultural and historic sites protection report prepared at end of construction period.	• Inspection by specialist who knows about cultural and historic sites. • Complaints by residents or members of cultural or historic site.	Before and After Irrigation Season.	Requirements specified in contracts Periodic inspections by MDF
	Soil impacts including waterlogged soil and salinization	N	• Better matching of water demand to farm location • Use of drip irrigation and other improved methods • Provide training to farmers on water conservation and more efficient water use • Use hydraulic structures to reduce soil and channel erosion • Inspect for waterlogging	• Channel water inspections • Reduced demand for water • Number of farmers using more efficient water systems	Before and After Irrigation Season, Monthly during Season	Requirements specified in contracts Periodic inspections by MDF
	Water impacts including excess water withdrawal poor irrigation methods, water quality and water quantity problems for downstream users	N	• Install water monitors and water measurement system • Appropriate water allocation formulas • Proper maintenance of irrigation channels, inspect for canal sedimentation • Improved farm techniques like land leveling methods • Measure water quality upstream and downstream • Encourage efficient farm	• Number of water monitors installed • Number of farmers with better use of chemicals and farm methods • Km channel maintenance	Before and After Irrigation Season, Monthly during Season	Requirements specified in contracts Periodic inspections by MDF

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			use of water • Proper use of pesticides and fertilizers			
	Socioeconomic Impacts	N	• Provide equitable access to irrigation water • Insure adequate water available to "tailenders"	• Complaints from farm users	Before and After Irrigation Season, Monthly during Season	Requirements specified in contracts Periodic inspections by MDF
	Public Health and Safety Impacts	N	• Monitor for pathogens and disease vectors • Periodically flush canals, clear clogged channels, drain waterlogged fields • Promote proper trash disposal practices, display "No Dumping" signs along canals and in communities. Provide factsheets and educational materials to schools and communities. • Protect children and local communities from accidental drowning through use of signs, factsheets (See example, http://www.lni.wa.gov/Safety/Research/FACE/files/ag_drown.pdf) and educational	• Monitor healthcare • Complaints from nearby residents	Before and After Irrigation Season, Monthly during Season	Requirements specified in contracts Periodic inspections by MDF

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			materials for schools.			
	Water, Soil and other Environmental Impacts due to weak Systemwide O&M Management System	N	• Collaborate with Mtkvari-M Ltd. to implement systemwide O&M management system to organize data collection, identify O&M problems throughout the irrigation network and design solutions including better canal operating guidance, preventive maintenance, program schedules and activities, training for stronger management systems for farmers and use of "how-to" guides and information of best practices. Covers monitoring for pathogens and disease vectors, water quantity metering, assessment of upstream and downstream waters, monitoring of drainage systems. Coordination of systems that identify water and soil problems	• Number of contributing organizations to overall system management system • Number of requests for assistance to improve irrigation water management • Number of inspections • Number of complaints from farmers, nearby residents and downstream water users.	Before and After Irrigation Season, Monthly during Season	Leadership and periodic inspections by MDF with initial start-up support from GMIP

Activity	Identified Environmental Impacts	Are Impacts Potentially Significant?	Mitigation Measure(s)	Monitoring Indicator(s)	Monitoring and Reporting Frequency	Responsible Party(ies)
			including salinity. This measure includes assistance with methods of conflict resolution associated with land and water rights. (Mtkvari-M Ltd. is a Georgian company that operates & maintains the Tiriponi and Saltvisi irrigation systems.)			

7. LIST OF PREPARERS

Baseline data collection, field studies, alternatives analyses, impact assessment and development of EMMPs and completion of this EA was conducted by a specialized team of scientists and engineers from Tetra Tech. Backgrounds of principal members of the EA Team are highlighted below:

James Gallup, Ph.D., P.E., Team Leader and Environmental Engineer. Dr. Gallup is a senior environmental engineer with over 40 years of international experience, including projects in Georgia. He led a team that prepared a Programmatic Environmental Assessment (PEA) for the USAID AgVANTAGE Project implemented by ACDI/VOCA. He has provided direct technical support to the Europe and Eurasia Bureau Environmental Officer and he designed and implemented USAID's Global Environmental Pollution Prevention Project (EP3). Dr. Gallup, a registered professional engineer, earned his Ph.D. in Environmental Engineering from the University of Oklahoma. He holds a BS in Microbiology and MS in Environmental Engineering.

Karen Menczer, Environmental Specialist. Ms. Menczer is an environmental specialist who has supported international development programs in Eastern Europe, Asia, Africa, Latin America and the Caribbean for more than 25 years. She has worked extensively with USAID, first as Biodiversity Advisor and Assistant BEO for LAC Bureau, then as Natural Resources Advisor and Mission Environmental Officer at USAID/Uganda, and most recently as an independent consultant focusing on preparing Reg 216 environmental documentation and biodiversity assessments, and conducting project evaluations. Ms. Menczer worked towards her Ph.D. at the University of New Mexico and in Galapagos, Ecuador. She holds an MS in Ecology and a BS in Biology.

Mamuka Shaorshadze, Environmental Specialist. Mr. Shaorshadze has 12 years relevant experience, most recently as an environmental supervisor on two Millennium Challenge Georgia (MCG) fund infrastructure programs. He also served as an Environmental Field Officer for the Georgian Oil and Gas Corporation initiatives funded by the MCG. Mr. Shaorshadze earned his Bachelor's Degree in International Economics from Georgian Technical University.

Mamuka Gvilava, Ph.D., Environmental Specialist. Dr. Gvilava is an environmental specialist with fifteen years experience in field work, project management, policy and regional cooperation. He has experience with environmental and social impact assessment, remote sensing and green design. He served as national focal point to the Black Sea Commission and project director of the World Bank and GEF Coastal Zone Management Project. He has a Ph.D. in physics and math.

8. APPENDICES

8.1 Irrigation Stakeholder Meeting (November 18, 2011)

8.2 Summary of Irrigation Rehabilitation Impacts Identified by Kav

8.3 Site Visit Engineering Report (November 25, 2011)

Appendix 8.1
Irrigation Stakeholder Meeting
November 18.2011

Georgia Municipal Infrastructure and IDP Housing Rehabilitation Project (GMIP)

Irrigation Rehabilitation Stakeholder Meeting

Multifunctional IDP Community Center
Verkhvebi Settlement
Gori Municipality
Gori, Georgia

November 18, 2011

2

1. Stakeholder Meeting Minutes (Scoping)

1.1 Introduction

Municipal Development Fund (MDF) of Georgia and TetraTech, in coordination with the project sponsor USAID-Georgia, organized Environmental Scoping Stakeholder Meeting for Irrigation Rehabilitation component of the Georgia Municipal infrastructure and IDP housing rehabilitation project (GMIP).

The stakeholder meeting was held on November 18, 2011 at 11:00 at Multifunctional IDP Community Center of the Verkhvebi Settlement, Gori Municipality, Georgia. The aim of the meeting was to provide project stakeholders with the information regarding the project, as well as to explain the technical as well as environmental issues important for the Environmental Assessment (EA) of GMIP irrigation rehabilitation component.

1.2 Itinerary

Notices about the meeting were posted in several local settlements located within the Saltvisi-Tiriponi rehabilitation area. Local self-governments' public information boards were used to display the announcements informing the public about meeting purpose and location. In addition to this, Mtkvari-M Ltd and its management office in Gori – the Government owned company in charge of the operation and maintenance of the irrigation scheme – the main beneficiary of the project component, were kindly requested to facilitate the invitation and participation of the project stakeholders, including its own staff concerned, former Water User Associations (WUA) as well as representatives of the local self-government and local public.

Photos of the public notices/announcements are provided in Annex A. Agenda of the meeting is reproduced in Annex B. Some photos documenting the meeting are provided in Annex C. List of participants (in English) / the registration sheet are provided in Annex D. Copy of the presentation is attached as Annex E.

The meeting, including it question and answer session was recorded in audio and webcam format, which is kept in project files. Presentation facilities at the meeting included overhead projector with PowerPoint file (in Georgian language). The meeting was logistically organized by MDF and TetraTech, while proceeding was facilitated by Mr. Mamuka Gvilava, Environmental Specialist of TetraTech, Georgia.

1.3 Presentations

After the presentation of the agenda and personal introduction of all participants the meeting was addressed with introductory statement by Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. He welcomed MDF, Mtkvari-M and WUA representatives as the participants and beneficiaries of the project, explained the purpose of the environmental meeting and briefly introduced the project organization and its irrigation component in particular.

On behalf of the project implementer the meeting was addressed by Mr. Paata Charakashvili, Head of Division, International Relations, MDF. He thanked and welcomed participants and described basic parameters of the project with over $54 million allocated by USAID to municipal, IDP and irrigation components of the project. The latter component is very important for the agricultural development. In the nearest future project procurement would be initiated and hopefully by March the contractor would be mobilized to initiate the rehabilitation works.

Technical description of the project was presented by Mr. Otar Magalashvili, Hydrotechnical Engineer, TetraTech, Georgia. He provided brief historical overview of irrigation in Shida Kartli, back as early as in 19th century, with major irrigation systems being established in 1930-s. Explained that Tskhinvali headworks is no more operational due to known events. New headworks (dam with pumping station) were recently put into operation on Didi Liakhvi. Due to limited funds and more sustainable economic figures, the priority was given to partially rehabilitate Saltvisi and Tiriponi schemes. Hydrology and irrigation network was further characterized, basic parameters of the existing and both to be rehabilitated schemes were explained. Characteristic photographs, demonstrating various locations along the network, major facilities and their need of repair was shown. Some areas are not de-facto accessible and these canals will not be rehabilitated. It was also explained that rehabilitation in Tiriponi would proceed in three phases.

Environmental scoping of the irrigation component of the GMIP project was presented by Mr. Mamuka Gvilava, Environmental Specialist of TetraTech, Georgia. Substance of the presentation was concerned with scoping issues such as potential project alternatives, key environmental issues of the project component to be considered in EA, etc. Presentation was closely following the PowerPoint file, which is reproduced in Annex E. After the presentation of the environmental scoping issues the presenter invited participants to raise their questions (Q&A session is reproduced in the next subsection). The presenter than facilitated the discussion session with stakeholders to identify and/or confirm key environmental issues. Results of this discussion is reported in the subsequent sub-section further below.

1.4 Questions & Answers

The participants were invited to raise their questions.

Question. *Mr. Mamuka Lomsadze, Gori Office Manager, Mtkvari-M. You mentioned sediments in your presentation. During Soviet times we used to dispose these sediments along the canals or rivers and then high waters would drift them away. Now it appears that we identify this as the problem. What is the recommendation, how should we identify disposal areas and how should we deal with the spoil?*

Response. Mr. Mamuka Gvilava, Environmental Specialist, TetraTech, Georgia. This is important question. At the scoping stage we do not have yet response to this issue, but it can be considered as the important environmental issue to be dealt with in the EA, which is indeed confirmed also by your question being raised at this meeting. As a preliminary consideration, most likely solution is to identify and allocate disposal areas in strategic locations along the schemes, with all the consequence for the analysis, such as in which particular locations, land tenure/ownership issues in the proposed areas etc., or alternatively, whenever possible, disposing of along the canal service roads, if this can be implemented in the environmentally safe and responsible manner.

Response. Mr. Paata Charakashvili, Head of Division, International Relations, MDF. Let me add that same is concerned with other construction waste as well, and as we are aware EA and Environmental Mitigation and Monitoring Plan (EMMP) are under preparation to deal with these issues. As our experience with the World Bank projects demonstrates, EMMP becomes part of the contractual obligation

for the construction contractor, and with EMMP it would be specified in detail where to deliver the wastes, where to dispose, how to prevent and control pollution such as spills from equipment. Monitoring of the contractor's performance will of cause be performed by us, together with TetraTech and all these issues will be strictly controlled and monitored, so that the contactor complies with the contractual obligations, thus avoiding severe penalties potentially imposed on them in case of non-compliance.

Response. Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. Let me add to important points already expressed that key issue with the spoils is whether they are contaminated or not with such as heavy metals or other hazardous substances, and we should be monitoring this. Obviously for uncontaminated spoil we should identify disposal areas, such as access roads, other areas where Mtkvari-M and communities are comfortable with. Technical specifications will require from contractor to comply with necessary requirements. Bottom line for our discussion here is that this is the important issue and it should be addressed.

Question. *Mr. Mamuka Lomsadze, Gori Office Manager, Mtkvari-M. Another issue I would like to raise is what to do with household waste including plastics which are frequently dumped by population into the channels, which is the practice since Soviet times? Solution of waste disposal problems within the villages might not be achieved in the short-term perspective and why don't we define some intermediate solutions, such as installing some grating barriers in canals to recover the floating debris to protect important facilities, such as siphons for instance.*

Response. Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. Such facilities are called Trash Screens. These can definitely be installed, and then you have to have equipment to remove the trash, with special nets or other tools. It would also be important to work closely with local authorities to identify disposal areas so that trash is recovered by Mtkvari-M and municipality then allocates landfill spaces to deposit it.

Response. Mr. Mamuka Gvilava, Environmental Specialist, TetraTech, Georgia. Let me reiterate that the purpose of the scoping process is to identify important environmental issues and address them when preparing EA. This issue definitely looks like an important one, and we already have at least one solution mentioned, but of cause we would explore other mitigations as well, including long term solutions, addressing source of the problem rather than applying only 'end of pipe' solution. Such longer term solutions can be defined as mitigation measures for operations phase, which should be addressed through the efforts of the operating company in coordination with authorities.

Question. *It is indeed nice that project will help us rehabilitate the system, but long term solution should probably be better funding of the Mtkvari-M, otherwise system will again fall in disrepair in pretty short time, unless enough budget and resources are provided to operating company.*

Response. Mr. Mamuka Gvilava, Environmental Specialist, TetraTech, Georgia. You are actually raising the very important issue of the operation and maintenance (O&M). Let's look at his issue from the environmental perspective. If there is no viable O&M Plan, there would not be the plan for addressing environmental issues as well, therefore adequate O&M is critical for sound environmental management as well.

Response. Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. As part of the program we recognize this as the important issue at the outset. As a partial solution we would specify the design contractor to lay out proper O&M Plan. Rehabilitation only will not ensure sustainability of the system. First step would be to come up with the O&M Plan as the deliverable, working together with designers and with Mtkvari-M. Another idea we have (not yet confirmed as the commitment) to include as part of

the constriction contract identification and rehabilitation/repair couple of local offices designated as service centers for Mtkvari-M.

Remark. Mr. Otar Magalashvili, Hydrotechnical Engineer, TetraTech, Georgia. Important issue considered in the feasibility report is the analysis of economic feasibility. Mtkvari-M should achieve profitability margin so that it can staff itself out and generate enough revenues to sustain its operations. Initial analysis shows that it can be profitable organization except for the coverage of the electricity bill for the operation of pumps. In this latter case the Government should probably provide funds to cover this part of the operational costs. Economic sustainability is therefore the important issue.

This concluded the Q&A session.

1.5 Discussions

Facilitator of the meeting invited participants to elaborate their opinion with regard to the pre-selected issues displayed on screen using PowerPoint projector.

Discussion issues. *How will equitable access to irrigated lands be addressed? Equitably shared benefits from production? Will there be adequate access to markets? Will farmers have enough demand for their production?*

Feedback of stakeholders. Mr. Mamuka Lomsadze, Gori Office Manager, Mtkvari-M. Unfortunately current irrigation system cannot be described as equitable. The flow irrigation is inherently unfair as those who manage to get access to water get the benefit and others downstream are left without access. Productivity also much lower with this system compared to drip irrigation or other modern methods.

V. Garejvari representative. This year things were definitely better than in the previous period. Still, there are many problems with community irrigation networks, where some parts of the community have better access to irrigation water than others.

Mr. Alexander Shakarashvili, Deputy Director of Mtkvari-M. Regarding the local networks, as you know Water User Associations formally do not exist anymore. WUA-s were not capable to perfectly manage the local level networks, but now situation is even worse, as the system is in nobody's hand at the local level. If these systems are handed over to Mtkvari-M (although there would be the need of significant funding as the network at the local level is in serious disrepair), we would expect to improve the management significantly. Even if it is not Mtkvari-M, there should be somebody in charge of the local systems.

Discussion issues. *What impact will the rehabilitation have on wetlands and downstream ecosystems?*

Feedback of stakeholders. Valuable wetland ecosystems are not known in the area, as mostly territories are used for agriculture. There are many waterlogged areas, but with improved irrigation these can be dealt with.

Question. *Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. I relation to the discussion theme, what about drainage issues, are there areas with poor drainage in the command area?*

Feedback of stakeholders. In Karaleti ground water table is high and there is believed to be high rate of groundwater flow horizons, located to about 1 m depth, and this is permanent feature rather than

sporadic/transient. This covers entire Karaleti area, near the Kveshi HPP. Finally this groundwater flow discharges into the stream gorge.

Discussion issues. *What are current land tenure arrangements?*

Feedback of stakeholders. As a result of the privatization of lands in 1990-s almost all local households now have access on average to 1-2 hectare land, but these lands (70-80%) still mostly are not registered in the public cadastral system due to lack of the registration funds due to social conditions (some 50 GEL is required for the registration formalities and typically some 200 GEL for land plot demarcation by cadastral private companies). Almost every household has the land in ownership, although large portion of population have not yet registered formally with the National Agency of Public Registry. There are few large land owners as well, up to 100 hectares, owned both by physical or legal entities (i.e. individuals or companies/organizations). There is a process going on towards the merger of some smaller individual pots, as larger areas up to 10 hectares are more efficient to operate profitably.

Discussion issues. *Are there differences in men's and women's roles and relationships that may affect the long-term future of the scheme and the environment?*

Feedback of stakeholders. Women have not much to do in the irrigation (this response resulted into noise and lively jokes among participants). Mtkvari-M people mentioned that woman are involved in water measuring. TetraTech suggested that woman could be very good and efficient in office work. Mr. Jeffrey Fredericks even suggested that woman could be an excellent resource in QA/QC type tasks of oversight over construction works. Some people confirmed that woman are sometimes using local level canals for washing. People did not confirm the use of irrigation water for drinking purposes. Primary use by households is for irrigation (at village plots, for instance) rather than anything else. It is also not believed that irrigation water is the source of illness from pathogens, woman did not report that children are suffering from parasite vectors via irrigation canals.

Discussion issues. *What is happening to the quality of the soil in the area? What are existing and future soil maintenance needs (e.g., will soil fertility decrease due to intensive cropping and nutrient leaching)? What changes have farmers observed in the last 30 years?*

Feedback of stakeholders. If proper chemicals and fertilizers are applied there seems no problem. Special measures are not applied (like gypsum etc.). No extension services are generally reported, but it was mentioned that OSCE provide certain equipment for soil testing (in v. Mejvriskhevi). Participants are not aware of the progress, but nobody heard any more details. Special associations were formed in couple of villages and they acquired these tools. Probably these services were attached to Ministry of Agriculture, and it was suggested by TetraTech to investigate the issue whether it would be useful to attach these services to Mtkvari-M. Mr. Jeffrey Fredericks noted that in other irrigation areas he is aware that WUA-s were given this capability (equipment and training). Feedback was somewhat skeptical on how successful these efforts were, though it was reported that not much is known by locals in Saltvisi and Tiriponi area.

Question. *Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party. I relation to the discussion theme, was there any incidence of severe damage to crops and vegetation due to very limited access to irrigation waters in last 3-4 years, in orchards in particular?*

Feedback of stakeholders. Nikozi area was immediately mentioned. In Saltvisi also, where there was a lack of water the vegetation actually was vanished. Khurvaleti area (Akhalsopeli and Shavshvebi villages in particular) also is suffering due to non-operation of the pumping and water storage scheme coupled with the Nadarbazevi Lake. In Shavshvebi, in particular, damage to hazelnut trees were mentioned as

these require larger quantities of water. If water would reliably come back locals report that villagers would immediately start recovering the vegetation, though it may take several years depending on the species, before harvesting of produce can be re-established. Last year as soon as people seen the water they started to deal with seedlings. Still, people are advise by Mtkvari-M to be cautious and not to invest in certain types of agricultural activities, if water cannot be guaranteed 100% in the specific area.

Discussion issues. *What is the potential for soil salinization or other long-term, cumulative effects?*

Feedback of stakeholders. Mtkvari-M reports that sometimes more water does not mean more productivity. In some areas soils are more base-type rather than acid, and lot of water washes out base chemistry and leads to rising levels of acidity. Sometimes local people complain to Mtkvari-M management that they have done all measures with enough water and chemicals/fertilizers applied, but still could not produce the profitable amount of crops. So it seems important to establish irrigation and agricultural practices which are optimal for particular kinds of soils. Today nobody implements special treatments like with gypsum etc., though people are rotating crops. Spatial distribution of various conditions of soils is not well known and it would be better to have soil quality assessments to prescribe right agricultural practices fit for the location. TetraTech management mentioned that satellite images could be used as the good tool to assess the acidity and other parameters of lands/soils.

Discussion issues. *Are there any current pest problems?*

Feedback of stakeholders. Mice, hamsters, snakes are the problem in winter time. Mtkvari-M is switching on irrigation in winter to allow population to control the mice with cold water drowning. Another type of problem mentioned is the low quality of agrichemicals and fertilizers.

Discussion issues. *What is the condition of the potable water supply? Are there potential health issues?*

Discussion issues. *What is the current incidence of water-borne diseases?*

Both of these themes were briefly addressed above.

Discussion issues. *Any important cultural or archaeological heritage issues along the irrigation network or in the area?*

Feedback of stakeholders. No feedback could be provided, it was more advised to ask specialists. TetraTech representatives mentioned beautiful churches in Zemo Nikozi, close to irrigation main canal.

Discussion issues. *What about fish resources, in canals, in rivers, what kind of fish?*

Feedback of stakeholders. Zonkari reservoir upstream Patara Liakhvi (in conflict area) used to be good resource for the fish. Fishing or fish was not quoted in canals now. When the canals were operating with gravitation scheme the fish was migrating into the main irrigation canals from River Didi Liakhvi. With dam and pumping station now this is not physically possible. In rivers not much local fish interest as well, still it was quoted that following species are present: gudgeon, barbel-mursa, trout less frequently (more abundant in mountainous areas).

Discussion issues. *Any migrating and/o game bird species in the area, birds of prey?*

Feedback of stakeholders. Quails are abundant and also ducks, cranes were quoted near rivers. Game hunting is popular activity by locals.

Discussion issues. *Any wildlife/mammals in the area?*

Feedback of stakeholders. In river riparian areas one could meet mammal wildlife species such as fox, jackal and alike, no bears, no roe dears, which are expected more in mountain areas.

Discussion issues. *What are the long-term prospects for maintaining canal and irrigation structures? Who will maintain them? How? Who will pay for maintenance?*

Discussion issues. *What realistically may happen when the project ends? What will the project area look like in 30 years?*

Both of these themes were briefly addressed above.

Discussion issues. *Mr. Jeffrey Fredericks, USAID/TetraTech, GMIP Chief of Party raised three issues/questions: (i) if there is a need or problem in accessing grazing areas in occupied zones over the canals? (ii) some of these canals and facilities could be quite dangerous due to high velocities of water flow, are there any reports of drowning of people? (iii) new groundwater irrigation facilities were observed in some places (outside Saltvisi-Tiriponi scheme), is this the trend which is likely to spread into project supported area as well?*

Feedback of stakeholders.

(i) In Mejvriskhevi this cross-canal grazing access is practiced. It would be desirable to discuss with local authorities / community leaders which are the most suitable locations. 3-4 crossings would be sufficient in areas between Didi and Patara Liakhvi section of main canal.

Mtkvari-M Gori representative mentioned also that the water drinking areas for cattle would be nice to organize, because in some places local people even destroyed concrete structures to allow their cows access the canal water for drinking by cattle.

Both of these suggestions were strongly encouraged and welcomed by TetraTech management for implementation. This will be included as the task for the design/construction contractor to agree together with Mtkvari-M and local community leaders.

(ii) Participants confirmed that there are frequent incidents of this nature. Just couple of weeks ago 3 children were drowned at Karbi headwork's. Locals considered that with irrigation canals there is less danger, but much more threat is at hydrotechnical facilities. Mr. Jeffrey Fredericks also recalled that during site visit at Didi Liakhvi dam site at Tiriponi young people were jumping into water in quite dangerous situation.

TetraTech management again suggested to consider this as the serious safety issue and equip at least all rehabilitated sites with safety controls, such as handrail barriers, safety screens at proper facilities etc. as well as with targeted signage to alert local people on dangers, as well as to provide some Mtkvari-M personnel guard facilities in strategic locations like Karbi.

(iii) Similar type of irrigation scheme was confirmed in Patara Garejvari area (there is a small lake which is collecting waters from irrigation channels), but generally groundwater irrigation cannot be considered as viable in Saltvisi-Tiriponi area, because with higher elevations groundwater goes to over 100 m depths.

This concluded the discussion session and the meeting. Organizers thanked local stakeholders for active participation in this very informative meeting. Participants were then kindly invited to have the modest lunch.

1.6 Conclusions

Meeting lasted from 11:00 to 13:00. It was well attended and organized as planned, and was very substantive. Participants were represented by various stakeholders, including representatives of operator company, local communities as well as local government authorities. Atmosphere at the meeting was quite relaxed, all those wishing to express their opinion were readily given such an opportunity. Female were at least 30% of participants. Meeting was facilitated by TetraTech environmental specialist, with moderating back-up by GMIP Cop. Project management was well represented by TetraTech team and key MDF representatives in charge of GMIP. Meeting premises, including projecting facilities were very convenient.

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2. Stakeholder Meeting Announcements

Photos of the announcements placed in several local settlements and copy of the text:

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ANNOUNCEMENT

USAID funded GMIP Project, Irrigation Component

Stakeholder Meeting (Environmental Scoping)

V. Verkhvebi, Gori Municipality

11:00, Friday, 18 November 2011

Municipal Development Fund of Georgia is pleased to announce that the stakeholder meeting to discuss the environmental scoping of the irrigation component of the USAID funded Municipal Infrastructure Rehabilitation Project (GMIP) will be held on Friday, 18 November 2011 at 11.00, at the following address: Multifunctional IDP Community Center, V. Verkhvebi, Gori Municipality.

GMIP Irrigation Component comprises the partial rehabilitation of the main channel, distributaries and hydrotechical facilities of the Tiriponi and Saltvisi irrigation schemes in Shida Kartli. The meeting will discuss the technical aspects of the irrigation component, as well as will consult with stakeholders on issues important for environmental scoping of this project component. Those interested to participate should contact meeting organizers at the address and contacts indicated below.

Municipal Development Fund of Georgia
Kartlos Gviniashvili, Project Officer
150 Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mobile: +995 (599) 42 57 90
E-mail: kgviniashvili@mdf.org.ge

Tetra Tech/USAID - Municipal Infrastructure and IDP Housing Rehabilitation Project
Mamuka Shaorshadze
Environmental Engineer
154, Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mob: +995 (595) 11 60 71
E-mail: mamuka.shaorshadze@tetratech.ge

3. Agenda of the Stakeholder Meeting:

A G E N D A

USAID funded GMIP Project, Irrigation Component

Stakeholder Meeting (Environmental Scoping)

V. Verkhvebi, Gori Municipality

11:00, Friday, 18 November 2011

1. Welcome and meeting objectives, introduction of all participants (MDF, USAID/TetraTech)

2. Introduction into technical aspects of GMIP irrigation component (Otar Magalashvili, Hydrotechical Engineer, TetraTech, Georgia)

3. Environmental scoping of the GMIP irrigation component (Mamuka Gvilava, Environmental Specialist, TetraTech, Georgia)

4. Discussion on potential key environmental issues of the irrigation component

5. Conclusions and meeting closure (MDF, USAID/TetraTech)

4. Stakeholder Meeting Photos

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5. Stakeholder Meeting Participants

List of Participants for Stakeholder Meeting 18.10.2011

	Name/Organization	Title	Signatures
	USAID		
1	Bradley Carr	Water, Irrigation and Infrastructure Advisor	
2	George Kokochashvili	Engineering Specialist	
	MDF		
3	Paata Charakashvili	Head ad of Division for Relations with International Organizations	
4	Zura ~~Baratashvili~~	Procurement Officer	
5	Kartlos Gviniashvili	Program Manager	
	Mtkvari M		
6	Tamaz Babutidze	Head of Pumping Station Meghvrekisi	
7	Mamuka Lomsadze	Gori Office Manager	
8	Guram Baramashvili	Chief of Channel Exploitation	
9	Tamaz Khvedelidze	Chief Engineer	
10	Dimitri Kavtuashvili	Head of Mtkmvari M	
	Tetra tech		
11	Jeff Fredericks	COP	
12	Mamuka Gvilava	Environmental Consultant	
13	Otar Maghalashvili	Irrigation engineer	
14	Archil Lezhava	Program Specialist/Public Outreach	
15	Mamuka Shaorshadze	Environmental Specialist	
16	Mark Jensen	Irrigation Consultant	
17	Maia Dvali	Translator	
	Attendees		
18	Tetunashvili Teimuraz	Tirdznisi Gamgebeli	
19	Samadashvili Tariel	Association Head	
20	Gholijashvili Tato	Association Head	
21	Gigauri Spiridon	Association Head	
22	Basilashvili Nino	Specialist	
23	Baramashvili Guram	Channel Exploitation Head	
24	Gholijashvili Nodar	Specialst at Karaleti Sakrebulo	
25	Mazmiashvili Manana	Specialist	
26	Basilashvili Evgeni		
27	Gogshelidze Tea		
28	Kebadze Sopo		
29	Gogshelidze Mamuka		
30	Tsiklauri Giorgi		
31			
32			
	Total	30 Persons	

6. Stakeholder Meeting Presentation

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Municipal Infrastructure and IDP Housing Rehabilitation Project (GMIP)

Irrigation Component

Stakeholder Meeting (Environmental Scoping)

November 18, 2011

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Objectives of the meeting:

- Introduction into GIMP
- Technical aspects of Irrigation Component
- Environmental Scoping of GMIP Irrigation Component
- Discussion on potential key environmental issues to be addressed in the EA

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Municipal Infrastructure and IDP Housing Rehabilitation Project

USAID | GEORGIA

Municipal Infrastructure and IDP Housing Rehabilitation Project

Implementation: Municipal Development Fund

Engineering oversight: Tetra Tech

Donor: USAID

USAID | GEORGIA

Location: Shida Kartli Region of Georgia

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Map: Saltvisi and Tiriponi irrigation systems

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Map: planned phases of rehabilitation

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Main features of Irrigation Component:

No	Irrigation system	Areas served before rehabilitation	Areas to be served after rehabilitation	Total
1	Saltvisi	1200 hectares 1342 households	8522 hectares 9740 households	9722 ha 11080 hh
2	Tiriponi	3520 hectares 3780 households	4980 hectares 10340 households	8500 ha 14120 hh
	Total	4720 hectares 5142 households	13502 hectares 20080 households	18222 ha 25200 hh

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Main activities of Irrigation Component:

- Rehabilitation of 30 km main canal and of 80 km of distributaries (NO new canals!):
  - Repair of damaged lining & disposal of concrete
  - Removal and safe disposal of sediments
  - Removal and reuse/disposal of canal vegetation
  - Installing new gates, flow meters
  - Repair of service roads

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Main activities of Irrigation Component:

- Rehabilitation of Karbi headworks
- Rehabilitation of other damaged critical irrigation facilities (gates, siphons, aqueducts, dukers, etc.)
- Partial rehabilitation of Saltvisi and Tiriponi systems (canals and facilities on occupied territories can not be repaired)

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Irrigation Component: **Environmental Scoping**

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SCREENING

National environmental requirements:

- EA not required (Law on Env. Impact)

International environmental requirements:

- EA required (US Federal Regulation 216)

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ALTERNATIVES

Alternative 1: no action
- unacceptable consequences

Alternative 2: proposed action
- feasible

Alternative 3: proposed + WUA/privatization
- institutional and regulatory risks

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ALTERNATIVES

Alternative 4: groundwater irrigation
- more expensive to install and operate

Alternative 5: closed pipe irrigation
- probably too expensive

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Potentially significant IMPACTS
(both for **construction** & for **operation**):

Threatened and protected species, habitats
- rapid biological appraisal

Hydraulic and hydrological systems, wetlands
- determine impacts on riparian habitats

Cultural heritage and archaeology
- rapid appraisal

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Potentially significant IMPACTS
(both for **construction** & for **operation**):

Intensified agriculture / expansion to new lands
- identify potentially affected ecological areas

Degradation of water quality, sediment loads
- determine points of potential contamination

Irrigation waterborne pathogen/disease vectors
- identify potential pathogens & transmission

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Potentially significant IMPACTS
(both for **construction** & for **operation**):

Cumulative impacts (irrigation & river systems)
- predict nature of cumulative impacts

Possible conflicts on land & water use
- identify and foresee potential conflicts

Aquatic species, fish migration (canals, rivers)
- rapid appraisal of aquatic resources

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Potentially significant IMPACTS
(both for **construction** & for **operation**):

Impacts from water temperature changes
- identify sensitivities with fish fauna, birds

Alterations to hydrology and watersheds
- consider watershed processes, including possible impacts caused by climate change

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MILESTONES:

- Environmental Assessment: January, 2012
- Technical design & tender: January, 2012
- Start of rehabilitation: Spring, 2012
- Completion of rehabilitation: 2 years

(no active construction in irrigation seasons)

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CONTACTS:

Municipal Development Fund

Kartlos Gvinianashvili, Project Officer
150 Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mobile: +995 (595) 42 07 90
E-mail: kgvinianashvili@mdf.org.ge

Tetra Tech:

Mamuka Shaorshadze, Environmental Engineer
154, Agmashenebeli Ave., 0112, Tbilisi, Georgia
Mobile: +995 (595) 11 60 71
E-mail: mamuka.shaorshadze@tetratech.ge

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QUESTIONS ?

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Potential environmental & social ISSUES

- How will equitable access to irrigated lands be addressed?
- Equitably shared benefits from production?
- Will there be adequate access to markets?
- Will farmers have enough demand for their production?

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Potential environmental & social ISSUES

- What impact will the rehabilitation have on wetlands and downstream ecosystems?

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Potential environmental & social ISSUES

- What are current land tenure arrangements?

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Potential environmental & social ISSUES

- Are there differences in men's and women's roles and relationships that may affect the long-term future of the scheme and the environment?

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Potential environmental & social ISSUES

- What is happening to the quality of the soil in the area? What are existing and future soil maintenance needs (e.g., will soil fertility decrease due to intensive cropping and nutrient leaching)? What changes have farmers observed in the last 30 years?

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Potential environmental & social ISSUES

- What is the potential for soil salinization or other long-term, cumulative effects?
- Are there any current pest problems?

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Potential environmental & social ISSUES

- What is the condition of the potable water supply? Are there potential health issues?

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Potential environmental & social ISSUES

- What is the current incidence of water-borne diseases?

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Potential environmental & social ISSUES

- What are the long-term prospects for maintaining canal and irrigation structures? Who will maintain them? How? Who will pay for maintenance?

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Potential environmental & social ISSUES

- What realistically may happen when the project ends? What will the project area look like in 30 years?

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Thank you for participation !

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APPENDIX 8.2: Summary of Irrigation Rehabilitation Impacts Identified by KAV

IMPACT (Description of effect) and occurrence (construction/operation)	Significance Determination Filter[1]				Are Consequences Significant? (Y) or (N) Positive impact (P)
	1 Subject of USAID or GoG Requirements[2]	2 Subject of Community Concern	3 Pollution Prevention Potential[3]	4 High Environmental Risk[4]	
Receptor: Soils, Geology and Landscape					
Rehabilitation phase:					
Disturbance or threat to important ecological habitats, including protected ecosystems (e.g. national parks) and/or other sensitive areas (e.g. wetland)					N
Visual disturbance due to construction/rehabilitation activities.					N
Contamination of soils due to accidental spill of fuel/oil and/or	X		X		Y

[1] Place an "X" in the appropriate column 1, 2, 3, or 4. A single "X" (the first one determined) is all that is required for a determination of significance.
[2] Subject to USAID requirements or specifically relevant legislation, regulation, and/or permit requirements. This will likely include effects associated with activities if (1) environmental regulations specify controls and conditions, (2) information must be provided to authorities, and/or (3) there may be periodic inspections or enforcement actions taken by authorities.
[3] Based on technical and business conditions, such as cost-effectiveness, has a high-potential for pollution prevention or resource-use reduction.
[4] Associated with potential impact to the environment from high environmental loading due to one or more of the following: scale, magnitude, probability, duration.

other technical liquids					
Contamination of soil due to uncontrolled disposal of construction waste	X		X		Y
Land clearance activities (e.g. trench excavation) could generate some amount of the topsoil to be stored properly, handled and reused.		X	X		Y
Operation/Maintenance Phase:					
Improvement of soil productivity					P
By inadequate exploitation of irrigation channels (high amount of water abstraction from the headwork) increasing of soil salinization and flooding.	X	X			Y
Receptor: water resources (surface and ground)					
Rehabilitation phase:					
Contamination of water due to accidental spill of fuel/oil and/or other technical liquids	X				Y
Lack of on-site sanitary facilities for construction workers causing pollution to surface and groundwater	X		X		Y
Pollution of surface water resources by constructed	X		X		Y

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materials (removed soil and old concrete slabs/plates).					
Operation/Maintenance Phase:					
Rational use of water resources resulted by decreasing of filtration in the channels after rehabilitation of destroyed channels					P
By inadequate exploitation of irrigation channels (high amount of water abstraction from the headwork) decreasing of water flow in the river	X	X			Y
Receptor: air quality					
Rehabilitation phase:					
Emissions from construction machinery, may increase the level of emission in the air	X				N
Removal of groundcover, borrow pits, and construction sites, creating conditions for airborne dust and particulates may increase the level of emission in the air and dust, especially under windy conditions.		X			Y
Operation/Maintenance Phase:					
No significant impact on air quality during					N/A

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operation/maintenance.					
Receptor: Biodiversity					
Construction/rehabilitation phase:					
Rehabilitation process may cause removal of vegetation cover, changes in land use pattern.					N
Operation/Maintenance Phase:					
Impact on ichthyofauna By inadequate exploitation of irrigation channels (high amount of water abstraction from the headwork), constraining fish migration (Karbi)	X				Y
No significant impact on vegetation cover during operation/maintenance					N
Socio-Economic, Community, Public Health, Cultural and Historical Assets					
Community					
Construction/Rehabilitation Phase:					
Disturbance of local community due to construction machinery, traffic and/or possible removal activities.		X			Y
Temporary employment					P

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opportunities in the construction activities (beneficial impact)					
Operation/Maintenance Phase:					
Improvement of livelihoods, increase of quality agricultural lands. Development of agriculture and income.					P
Public Health					
Rehabilitation Phase:					
Inadequate management of temporary sanitation facilities for workers could cause negative impact on public health during	X		X		Y
Operation/Maintenance Phase:					
					N/A
Archaeology and historical monuments					
Rehabilitation Phase:					
Impact on archeological and historical heritage					N
Operation/Maintenance Phase:					
During operation impact on archeological and historical monument not possible					N

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Definitions Used in Determining Environmental Risk

Parameter	Rating Categories				
	1	2	3	4	5
Scale	Insignificant volume/quantity	Low volume/quantity	Medium volume/quantity	Medium volume/quantity	High volume/quantity
Severity	Minimal impact	Moderate impact but localized and readily containable	Moderate impact over multiple locations	Significant impact and/or regional	Extreme impact and/or potential for global impact
Probability	Very unlikely under any operating condition	Occurs during abnormal/emergency conditions. Probability anticipated and managed	Occurs during routine maintenance activities	Occurs during major maintenance activities	Occurring during normal operating conditions
Duration	Spike situation extremely short-term duration within one day	Less than one month	One to six months	Less than one year	Long-term duration greater than one year or continuous

USAID
FROM THE AMERICAN PEOPLE

ENVIRONMENTAL ASSESSMENT:

FOR IRRIGATION REHABILITATION ACTIVITIES

GEORGIA MUNICIPAL INFRASTRUCTURE AND IDP HOUSING REHABILITATION PROJECT

DCN: 20 10-GEO-033

APPENDIX 8.3

Date: January 2012

DISCLAIMER

The author's views expressed in this publication do not necessarily reflect the views of the United States Agency for International Development or the United States Government

Appendix 8.3
Site Visit Engineering report
Saltvisi and Tiriponi Irrigation Systems

Date: November 25, 2011 (Final)

Prepared by: Otar Maghalashvili

Reviewed by: Mark Jensen

Approved by: J. Fredericks

Subject: Saltvisi and Tiriponi Irrigation Systems

1. Purpose:

Review of "Kavgiprotrans-MG" Ltd (KAV) feasibility study results for the Tiriponi and Saltvisi Irrigation Systems.

2. Recommendations:

1. Project construction cost estimates:
   As a result of the site visits; review of Hydrosphere Report, 2009 (Project For Rehabilitation of Tiriponi and Saltvisi Irrigation Systems); OSCE Report prepared by Flag International LTC, December 2008 (ERP Irrigation Assessment Report), and discussions with "Mtkvari M" it is recommended to accept the KAV/MDF project costs.
   - The KAV costs for Saltvisi without contingencies are USD 2.8 M.
   - The KAV costs for Tiriponi for Phase 1without contingencies are USD 4.2 M.
2. Final Cost estimates should be elaborated by the designer under the proposed design/build contract.
3. Table 1 Tiriponi & Table 2 Saltvisi (section 5. Findings/Recommendations below) list the works not detailed by KAV in their feasibility report. These items should be considered in the design and rehab of Tiriponi Saltvisi irrigation systems.
4. Items listed in the attached Ltd "Mtkvari-M" letter to support their O&M program should be considered and if possible included in the MDF Design/Build procurement package for Tiriponi & Saltvisi.
5. The maximum area that can be irrigated based on the available water supply should be evaluated by the MDF Design/Build contractor.
6. For Tiriponi the option of irrigating lower areas in the system by gravity from the numerous small streams/rivers that pass through Tiriponi Irrigation system should be reviewed during the design phase.
7. Inventory by KAV was conducted during irrigation season. Tt conducted its site visits after the irrigation season. This allowed Tt to identify additional problems such as washed out foundations; damaged syphons, etc. not detected by KAV during their site visits.

3. Background:

The Tiriponi and Saltvisi irrigation schemes in Shida Kartli Region were identified by GoG as priority targets for USAID technical assistance. These systems were impacted by Georgia's 2008 conflict with Russia. Both schemes previously received water from the same head works located on the Didi Liakhvi River at Tskhinvali. The head works is now in the occupied zone and flow to the two schemes was cut-off in 2008. To adjust to this situation GoG constructed a new diversion dam and pumping station at Kvemo Nikozi, Gori District several kilometers downstream of the old head works. The new pump station has 6 pumps. A 7th pump is being installed for Saltvisi and should be ready for the start of the 2012 irrigation season. The original design anticipated that six pumps would serve Tiriponi. However during 2011 irrigation season five pumps were serving Tiriponi and one was serving Saltvisi.

USAID under the Municipal Infrastructure and IDP Housing Rehabilitation Project has agreed to fund up to $8.1 million on the irrigation infrastructure for these two schemes. The rehabilitation is expected to impact about 18,000 hectares of rural land, restoring productive capacity and helping more than 20,000 small farmer households to increase agricultural productivity. The works will include complete rehabilitation of main and secondary canals for Saltvisi irrigation system (9,722 ha) and the rehabilitation of Karbi head works and the main & secondary canals of Tiriponi irrigation system (8,500 ha) up to the first crossing of occupied territory.

Tiriponi Irrigation System:

The primary source of water for the Tiriponi irrigation systems is from the newly constructed diversion dam and pump station located on the Didi Liakhvi River at Kvemo Nikozi. The original design plan for 6 pumps to supply Tiriponi with a total capacity of 8 m^3/s (1.33 m^3/s per pump). For the 2011 season GoG decided to use one of the six pumps to supply Saltvisi. Therefore currently only 5 pumps are providing water to Tiriponi. The water is pumped 815m through two 1400 mm diameter pipes to Km 3.736 of the Tiriponi Main Canal between the villages of Ergneti and Megvrekisi. A second source of irrigation water for Tiriponi is the Patara Liakhvi River gravity flow diversion structure at the existing Karbi head works ($2m^3/s$). There are various other small rivers (Patara Liakhvi, Akura, Mejuda, Tortla, Lagomakhevi, Bersheula, and Charebula) that cross through the command area that are used for local irrigation. With the currently available water supply of $10m^3/s$ the potential irrigable area after full rehabilitation was estimated by KAV at 20,000 ha out of the original 28,390 ha.

Rehabilitation works have been divided into three phases (See Map in the Attachment 1). The USAID project will rehabilitate the first phase which includes: Karbi Head works, Tiriponi main canal (17.252 km) from Km 3.736 up to Km 20.51 (point at which main canal crosses into occupied territory), associated Tiriponi Phase 1 main canal structures (one gallery, 2 tunnels, 3 aqueduct, and 4 syphons), and Tiriponi main distributaries (43.37 km) in the phase 1 area (G-1, G-1.1, G-1.2, G-1.3,G-2, G-3, G-3.1, G-3-1). The cost with contingencies for rehabilitating the first phase of the Tiriponi system was estimated by KAV at 7.123 M GEL (4.317 M USD). The project is designed to irrigate an area of 8,500 ha.

For Karbi head works proposed rehabilitation includes removal of sediment, restoring concrete on the diversion dam and intake, bank protection works, cleaning the riverbed, restoring the flushing galleries, arrangement of trash rack for the head works, restoring/repairing the regulating gates, replacing and

providing mechanical & electrical system for lifting of the gates, providing on-site housing for operator, constructing a fish by-pass, and installing a flow measurement capability.

For the canal systems proposed works will include cleaning the channels of vegetation and sediment deposits to make them more hydraulically efficient; repairing and improving the linings of the damaged sections of the channels to make them more water tight and hydraulically efficient; determining and eliminating points of excess canal seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing and graveling the access roads.

Expected number of beneficiaries total 14,120 households including 5,500 IDPs. 20 villages will be supplied by irrigation water. 16/24 months are assigned for rehabilitation and 4 months for preparing design. Economical features: cost per hectare is 508 USD. EIRR 28% (KAV)

Saltvisi Irrigation System:

The Saltvisi system will receive all its water from the newly constructed diversion dam on the Didi Liakhvi River at Kvemo Nikozi from two sources: a) from the Tiriponi pump station located on the left bank and b) through a gravity intake regulator on the right bank. A seventh pump with a capacity of 1.5 m^3/s is being installed at the Tiriponi pump stations for Saltvisi and should be ready for the 2012 irrigation season. The water for Saltvisi will be pumped 3 km through a recently constructed pipeline and discharged directly into the Saltvisi main canal at a location 4 km downstream from the original head works. During the latter part of the 2011 irrigation season Saltvisi main canal was temporarily provided water from one of the six pumps already installed at the Tiriponi Pump Station. For planning purposes KAV assumed that only one pump (1.5 m^3/s) would be used for Saltvisi in the future. The area to be served by pumped irrigation was estimated by KAV at 3,000 ha. The Nikozi gravity off-take on the right bank and the related downstream off-take canal were designed with a capacity of Bm^3/s. The off-take canal conveys water 800 m to a bifurcation structure that diverts water into the Didi Ru distribution canal (2 m^3/s) and the Dzlevisjvari distributary canal ($6m^3/s$). Only the secondary system (G1, G2, Dzlevisjvari, & gravity channels) serving the area (6,722 ha) downstream from the Dzlevisjvari distributary canal will be rehabilitated under the USAID program. The total planned irrigated area under the rehabilitated Saltvisi scheme was estimated by KAV at 9,722 ha. It may be possible to provide irrigation water to serve additional areas i.e. those areas located between Saltvisi main canal and the lower Saltvisi gravity channel by using the second Tiriponi pump originally designed for Tiriponi irrigation system and/or using small mobile pumps to pump from the Dzlevisjvari/gravity distributary canal. The total cost with contingencies for rehabilitation of the Saltvisi system was estimated by KAV at 5,637 M GEL / 3.417 M USD.

Rehabilitation works will be conducted on the following: main canal (4.6 km), G-1 distribution channel (21 km), G-2 distribution channel (9 km), former Dzlevisjvari channel (4 km), and a newly excavated gravity channel (8 km).

Works to be carried out include cleaning the channels of vegetation and sediment deposits; restoring and shaping the channel cut in earth lined sections; lining the bed and slopes of the channel in proposed lined sections; repairing and improving the linings of the damaged sections of the lined channels to make them more water tight and hydraulically efficient; determining and eliminating points of excess canal seepage; repairing/replacing distribution and conveyance structures; providing flow measurement capability at key locations; and repairing and graveling the access roads.

The number of beneficiaries was estimated by KAV at 11,080 households including 5,020 IDP families in 11 villages. Design and construction period will take 15 months. The estimated cost per hectare is 351 USD. EIRR 28% (KAV)

4. Methodology

The report was prepared based on the several site visits during September and October 2011. Meetings were held with Alexandre Shakarashvili, director of Ltd "Mtkvari-M" and Mamuka Lomsadze, manager of Gori Service Centre. Structures of the irrigation systems were inspected together with Givi Baramashvili, head of the District.

The main structures on both main channels and 1st level distributaries were inventoried during the site visits. Description and conclusions are provided in separate tables in section 5. Findings/Recommendations.

The report includes scanned images of hydrological structures and drawings which were delivered by Givi Baramashvili, Head of the District. The drawings were prepared in 1950 and Tetra Tech considered it necessary to create an electronic copy of the drawings. They have been included as attachments 5&6. GPS coordinates have been taken on the irrigation systems.

5. Findings/Recommendations

Table 1: Tiriponi Irrigation System

Survey stake/ photo	existing situation, recommendations
/698-709	**1. Karbi headwork on the river Patara Liakhvi**. Reinforcement on the left bank in upper and lower sides of the dam needs to be restored, filling the damaged part of the dam with concrete, plastering the damaged surface of the concrete, repairing/restoring the regulation gates, installing four new hoists connected with energy supply, cleaning the bed and channel from sediments, cleaning and repairing flushing galleries, restoring the damaged part of the railing. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Reinforcement on the left bank in upper and lower sides of the dam needs to be restored, stoplogs need to be arranged on the dam and channel gates, racks needs to be arranged to protect the channel from garbage, works to regulate right branch of the river should be carried out, alarm system should be installed in case of huge water overconsumption, hydro posts has to be arranged on the gates and in channel for measuring water level. Arrangement of watch post, toilet, drinking water and fencing of the area should be considered as well. Outdoor lighting needs to be arranged on the site and engines of the gates should be supplied with electricity.
37-36/ 731-735	**2. Main channel** The point where water flows from the pump station pressure pipe to the

Survey stake/ photo	existing situation, recommendations
	open gallery on the main channel. The locals dropped big rocks and pieces of concrete in order to accumulate water in the gallery and irrigate their areas. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Arranging the new line ø 200 mm along the pressure pipe, same as on the right branch. Afterwards, gallery should be cleaned out from concrete pieces and rocks. Fencing of the area should be considered as well.
95+20-100+18/ 710,711	Syphon on the river Patara Liakhvi, with four threads and 498 m length of reinforced concrete pipes ø1.5 m. One pipe is damaged and water flows with high pressure. Concrete surfaces are damaged on both bulkheads; there are railing and racks on the entrance bulkheads to protect from garbage. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering of concrete surfaces on both wells, arranging railing and racks on the entrance well to protect for the garbage.
123+80/ 712,713	Bridge on the channel. Railing is arranged on one side only. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Arranging the railing with steel pipes on the other side of the bridge.
103+76/ 714,715	Headwork of outlet with distribution well on G-2. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Increasing the height of concrete wall of the distribution well up to 1 m; installing 2 gates with hoists. The height of all the wells on of irrigation system should be raised up respectively.
120+45-120+87/ 716-720	Syphon on Charebula gorge, with 2 threads and 42 m long reinforce concrete pipes. Concrete surfaces are damaged on both bulkheads. There are no railing and racks to protect from garbage. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering concrete surfaces on both bulkheads, arranging of railings and racks to protect from garbage the entrance bulkhead.
132+17/ 721	Reinforced flume on the channel for pedestrians. The next structures located within occupied territory. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Necessity to arrange footbridge needs to be defined.
168+33-168+52/ 736, 737	Syphon on Bobona gorge with threads and 19 m long reinforced pipes ø 2.5 m. Concrete surfaces are damaged on both bulkheads. There are railing and racks on the entrance bulkhead to protect from garbage. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering concrete surfaces on both bulkheads, arranging railings and racks to protect from garbage on the entrance bulkhead.
181+03/ 738-743	Headwork for two outlets: the first for energy supply and second for irrigation – headwork of G-3 distribution channel. Water retaining

Survey stake/ photo	existing situation, recommendations
	structure with two pipes.
209+85-210+09/ 786-796	Aqueduct on Arceula gorge, bordering the occupied area. Seven steel pipes are arranged on the foundation of aqueduct (that is what is actually left from the structure). Two pipes are arranged above five ø1.0 pipes with 24 m of length. Foundations are partly washed out up to concrete base by irrigation and storm waters. The aqueduct needs to be rehabilitated up to initial condition. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Some works for strengthening foundation should be conducted before restoring the aqueduct.
229+61-230+17/ 318-335	The structure is located at the border of occupied territory. Aqueduct on Adzura gorge with 56 m of length, with the shape of arch. At some sections there is a problem of leakage. Connection point of outlet and its piping is purely installed. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Piers need to be checked, hydro isolating works need to be conducted, and new outlet structure should be restored in case of necessity.
259+53-264+27/ 847-859	Syphon on the river Mejuda with 2 threads and 474 m long reinforced concrete pipes. Entrance bulkhead of the syphon with spillway: concrete surface is damaged; there are no racks to protect from garbage and railing as well. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering the concrete surface on both bulkheads racks to protect from garbage and railing needs to be arranged on the entrance bulkhead; hoists of two gates should be changed also.
259+53-264+27/ 851-858	The same syphon; the part of the syphon which is relied on the piers. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering the concrete surfaces. Foundations of the piers need to be checked as there is a section of washed out foundation.
259+53-264+27/ 859-867	The same syphon, entrance bulkhead and initial part of a new tunnel. The bulkhead is a 52 m long rectangular concrete flume with three gates which provide with water the new tunnel, old main line and the settlers. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Plastering of concrete surface, changing of lifting structure for two gates. It is preferable to replace two gates with 2 m of length with smaller ones.
281+79-282+31/ 867-872	Exit of the channel (281+79) joined with the gallery with 75 m of length which is connected to the new syphon (282+31). The village gets water from the broken gallery and syphon. Large amount of water is flowing in the streets of the village (photo: 868,870). **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Arranging An additional outlet for the village water supply and filling the broken sections with concrete.

Survey stake/ photo	existing situation, recommendations
320+25-325+43/ 876-880	518 m long syphon at the end of the channel which joins the tunnel at 325+45; wall of exit bulkhead is broken along the whole height. The water flows nearby from short pipe to G-5. The water flows in bulkhead foundation. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Repairing of broken wall and foundation of the bulkhead and arranging outlet for G-5.
333+45-337+65/ 883-881	Exit of the tunnel at 333+45. Tunnel (800 m of length) joins 16 m long concrete flume. The flume has a branching – spillway. The main part of the flume is connected with the next syphon (333+45-337+65) which then joins the lined channel with trapezoidal cut.
37+36/ 811-816	3. Distribution channels **G – 1** The headwork of G-1 is arranged 610 m away the main channel at the point where channel gets water from pressure pipe at the village Meghvikisi. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Adjusting location of the headwork on the layout. Initial section of the channel – pipe beside and under the road needs to be repaired.
0+00 (103+76)/ 714,715, 723-730	**G – 2** The length of G – 2 is 3300 m according the data provided by Ltd "Mtkvari –M" and information gained during onsite inspections. Lining of the channel is extremely damaged due to the cleaning activities conducted by excavator. Existing gates with their hoists need to be replaced. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Direction and length of service road for the channel should be adjusted on the layout. E.g. water retaining structure needs to be arranged in the channel for maintaining horizon of the water. A culvert should be arranged at the same section and at 2+20. Work volumes to be defined according the study conducted by Ltd "Hydrosphere".
0+00 (181+03)/ 738-741	**G – 3** Headwork with water retaining structures. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Work volumes to be defined according the study conducted by Ltd "Hydrosphere".
1+70/ 750-753	Broken bridge at the road crossing. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Work volumes to be defined according the study conducted by Ltd "Hydrosphere".
0+00 (6+20)/ 797-802	**G – 3 - 1** Headwork

Survey stake/ photo	existing situation, recommendations
801,802	Crossing point of gorge and channel. After raising its level, water flows into the channel.
803,804	Surface of the culvert is damaged.
20+53	Service road is cut. Holes are full with surface waters. There is no culvert and outlet.
31+75	Syphon on Charebula gorge. In case of insufficient water supply, population for irrigation uses water which flows from the gorge and for that is why they have removed slabs of channel slope. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Increasing the height of the channel walls where water flows from the gorge into the channel; arranging protective concrete layer on the existing culvert; at 20+53: arranging a culvert with spillway for repairing the road; filling holes, restoring top layer of the road; at 31+75: elaborating bonding (for using water from the gorge) which will supply village settlers with irrigation water.

Table 2: Saltvisi Irrigation System

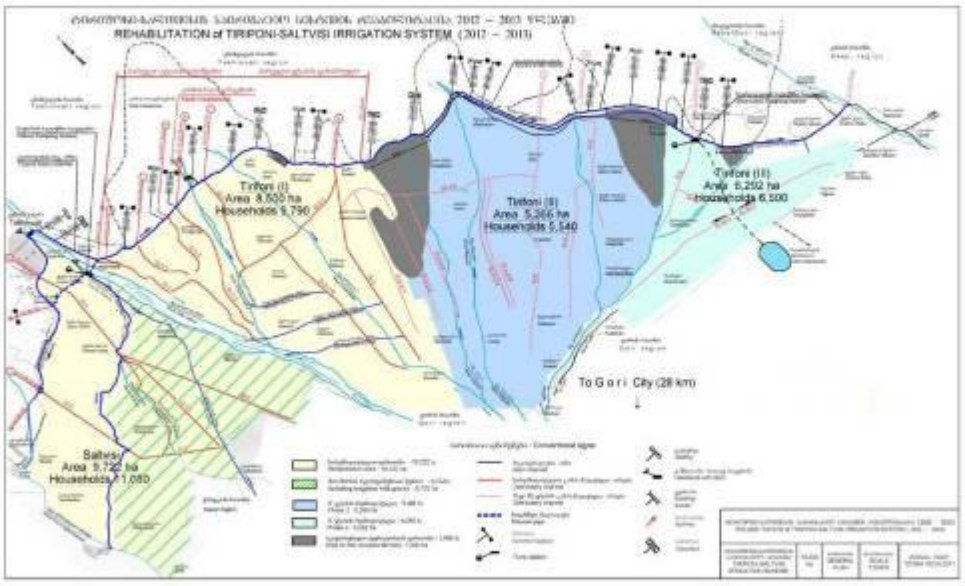
(GPS) Coordinates	Stake Survey/ Photos	Existing situation, recommendations
1 03.10.11	41+05/ 820-829	**1. Main channel.** Point where water discharges from pump station pressure pipe to the gallery on main channel. **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Adjusting the point where the last section of pressure pipe service road joins the main channel.
2 03.10.11	830	The bridge, outlet.
3 03.10.11	832,833	The bridge, vil. Zemo Khviti
4 03.10.11	835,836	The bridge, the section is filled with soil, rocks and sediments.
5 03.10.11	830-838	The bridge on G – 2, vil. Khelqtseuli
6 03.10.11	839	The new channel at the exit of the vil. Khelqtseuli; culver, earth channel.
		2. Distribution channels. **G – 1** **The following has to be added to Ltd "Kavgiprotrans-MG" project:**

(GPS) Coordinates	Stake Survey/ Photos	Existing situation, recommendations
		Work volumes should be defined according the study conducted by Ltd Hydrosphere".
		G – 2 **The following has to be added to Ltd "Kavgiprotrans-MG" project:** Work volumes should be defined according the study conducted by Ltd Hydrosphere".

Attachments:

1. Map of Project Area
2. Tiriponi/Saltvisi Irrigation System Salient Feature Comparison Table
3. Saltvisi and Tiriponi Main Canal Inventory
4. Saltvisi and Tiriponi Main Canal Structure Inventory
5. Main drawing of Tiriponi Irrigation System and GPS coordinates of the channels.
6. Main drawing of Saltvisi Irrigation System and GPS coordinates of the channels.
7. Request letter from Ltd "Mtkvari-M".
8. GPS Points & Google Map
9. Photos: Tiriponi and Saltvisi irrigation system photos.

Attachment 1: Tiriponi and Saltvisi Irrigation Scheme Project Map



Attachment 2: Salient Feature Table

Tiriponi/Saltvisi Irrigation System Salient Feature Comparison Table

	Distributive channels	discharge m^3/sec.			Length of the channel			Areas served		
		Mtkvari M	OSCE	KAV	Mtkvari M	OSCE	KAV	Mtkvari M	OSCE	KAV
1	2	3	4	5	6	7	8	9	10	11
	Saltvisi									
1	G-1	1.2			16700		21000			946
2	G-2	3			3440		9000			1554
3	Transfer channel			8			8000			4722
	Didi Ru channel			2						
4	Dzlevijvari channel			2			4000			2000
5	Saltvisi main channel			1,5 pump	9000		4600			500
	Sum									9722
	Tiriponi									
1	G-1	0.5			3939		3500	881		880
	G-1-1,2,3				1200		1200			1650
2	G-2	0.5					5000	550		550
3	G-3	7			11070		11070	1720		1720
4	G-3-1	2			6833		6000	1500		1500
5	G-3-1-2	1.2			8250					
6	G-3-1-3	0.6			5060					
7	G-3-1-6	1.2			8250		7500	350		350
15	Dzevera Shertuli channel	2.5			8445			600		
16	Tiriponi main channel	14			51000			12891		1850
17	Channel for local waters							2065		
	Sum									8500

Attachment 3: Saltvisi and Tiriponi Main Canal Inventory (OSCE)

Saltvisi Inventory – Main Canal

Survey stake		Distance	Canal	Depth	Bottom width	Top width	Cross section		Canal type		Mean velocity	Discharge, Q
from	to	m	slope	m	m	m	Area, m^2	Trapezoidal	Lined	Earthen	m/s	m^3/s
40+10	41+05	95	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
41+00	41+59	59	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
41+59	45+40	381	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
45+40	45+65	15	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
45+65	45+80	35	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
45+80	48+77	297	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
48+77	51+30	253	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
51+30	86+84	3554	0.005	1.98	2.6	6.3	8.8	X		X	0.68	6
86+84	94+76	792	0.001	1.3	1	3.6	3	X	X		1.57	5

Mtkvari Melioration Ltd. reported that the main canal is silted (0.7m) and needs cleaning.
There is a branch (2) departing from Saltvisi main canal at DM 86+84, that is considered by the Mtkveri Melioration Ltd. as an extension of the Saltvisi main canal but, in this report it is included as a secondary canal with all its structures. Branch 2 extends to 162+56, from this point to 200+00 they also reported that

Tiriphoni Network Inventory – Main Canal

Survey stake		Distance	Canal	Depth	Bottom width	Top width	Cross section				Canal type		Mean velocity	Discharge Q
From	To	m	slope	m	m	m	Area, m^2	Trapezoidal	Rectangular	Parabolic	Lined	Earth	m/s	m^3/s
27+60	53+09	2649	0.0002	3.5	6	9	26.3	X			X		0.42	
37+96		0	0.0002	3.5	6	9	26.3	X			X		0.42	8
54+18	57+50	332	0.0002	3.5	6	9	26.3	X			X		0.42	8
57+50	60+50	300	0.0002	2.4	6	9	18	X			X		0.61	8
60+50	75+47	1497	0.0002	3.5	6	9	26.3	X			X		0.42	8
75+97	78+50	153	0.0002	3.5	6	9	26.3	X			X		0.42	8
78+50	85+40	690	0.0002	2	6	9	15	X			X		0.73	8
85+62	95+20	958	0.0002	2	6	9	15	X			X		0.73	8
00+18	03+83	365	0.0002	2	6	9	15	X			X		0.73	8
103+82	120+45	1662	0.0002	2.1	6	9	15.8	X			X		0.7	10
120+87	121+40	53	0.0002	2.1	6	9	15.8	X			X		0.7	10
121+40	137+47	1615	0.0002	1.8	6	9	13.5	X			X		0.83	10
137+53	143+34	581	0.0002	1.8	6	9	13.5	X			X		0.83	10
143+34	157+34	1400	0.0002	1.8	6	9	13.5	X			X		0.83	10
157+34	159+70	236	0.0002	1.8	6	9	13.5	X			X		0.83	10
159+20	161+00	180	0.0002	1.8	6	9	13.5	X			X		0.83	10
161+00	168+33	733	0.0002	1.5	4	7.9	8.7	X			X		1.03	9
168+52	188+00	1948	0.0002	1.5	4	7.9	8.7	X			X		1.03	9
188+00	193+40	540	0.0002	1.3	4	6.6	6.9	X			X		0.75	5
193+40	209+85	1645	0.0002	1.3	4	6.6	6.9	X			X		0.73	5
209+98	218+50	852	0.0002	1.3	4	6.6	6.9	X			X		0.73	5
218+50	229+61	111	0.0002	1.3	3	5.6	5.6	X			X		0.72	4
229+61	230+97	98	0.0002	1.3	3	5.6	5.6	X			X		0.72	4
230+97	234+10	313	0.0002	1.3	3	5.6	5.6	X			X		0.72	4
234+10	247+20	1310	0.0002	1.3	3	5.6	5.6	X			X		0.72	4

Attachment 4: Saltvisi and Tiriponi Structure Inventory (OSCE/Tt)

Saltvisi Network Inventory – Main Canal Structures

Survey stake		Distance	Structure							Condition
From	To	m	Aqueduct	Gallery	Siphon	Bridge	Offtakes	Overchute	Other	
41+05	41+30	25			3.6x1.5					Needs cleaning
41+89						X				
45+40							X	X		
45+55										
45+90							X			
48+77						X				
51+30							X			
86+84							X			
87+88								X		
94+76	94+79	3	X							
96+30									Spillway	

*96+30 Dimention mark where the channel joins Mtirala

Tiriphoni Network Inventory – Main Canal Structures

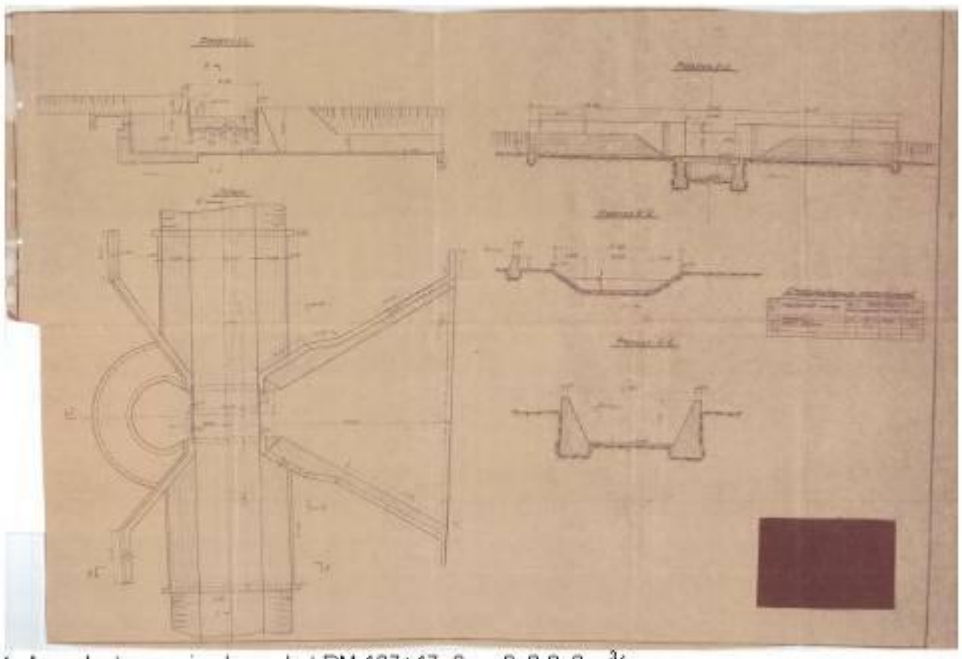
Survey stake		Distance	Structure							Condition
From	To	m	Aqueduct	Gallery	Siphon	Bridge	Offtake	Tunnel	Other	
27+60	46+06	1856								
37+66									X	
43+16							G-1			
46+06						X				
46+06	53+99	793				20x10				
53+99	54+18	19			2.3x19					Good
54+18	57+50	332								
58+34							G-1-1 0.6x2.5			Good
68+47							0.6x2.5			Good
72+87							0.6x2.5			Good
75+47	76+97	150		8.0x2.5						Needs cleaning
76+97	78+50	153				4.5x9.5				Blocked
78+50	85+40	690								
79+07							G-1-2 0.6x2.5			
79+80						4.5x9.5				
79+80							0.6x2.5			
82+65						4.5x9.5				
85+20				13			0.6x2.5			
85+40	85+50	10	X							

Tiriphoni Network Inventory – Main Canal Structures

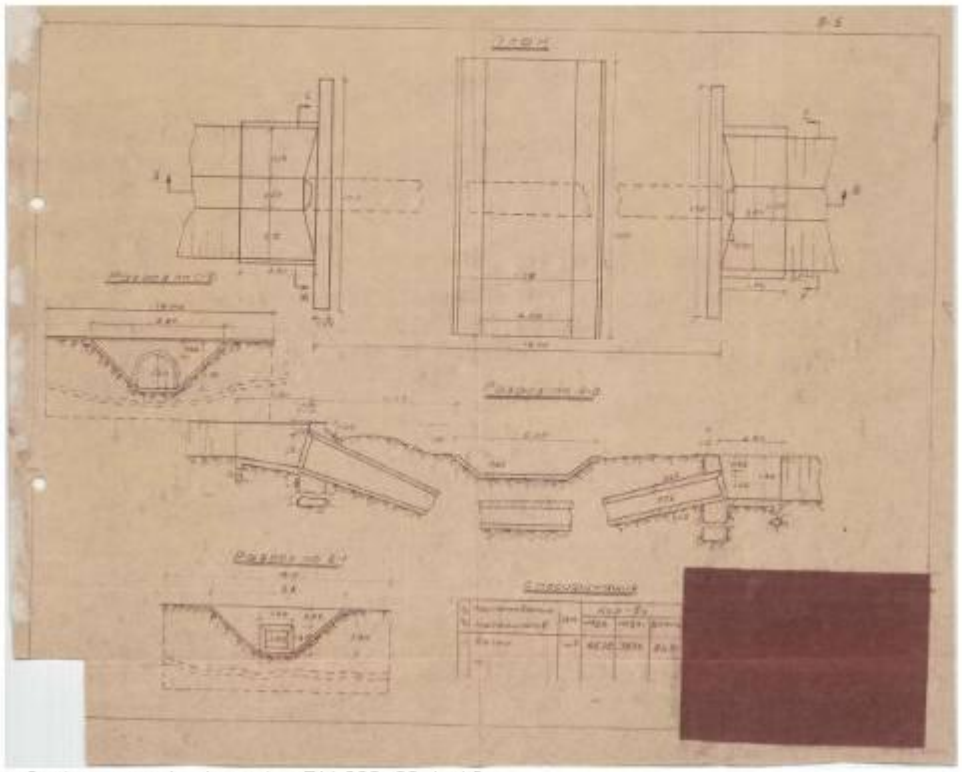
Survey stake		Distance	Structure							Condition
From	To	m	Aqueduct	Gallery	Siphon	Bridge	Offtake	Tunnel	Other	
27+50	46+06	1856								
37+36									X	
43+46							G-1			
46+06						X				
46+06	53+99	793				20x10				
53+99	54+18	19			2.3x1.9					Good
54+18	57+50	332								
58+34							G-1-1;			Good
68+47							0.8x2.5			Good
72+87							0.8x2.5			Good
75+47	76+97	150		6.0x2.5						Needs
76+97	78+50	153				4.5x9.5				Blocked
78+50	85+40	690								
79+37							G-1-2;			
79+80						4.5x9.5				
79+90							0.8x2.5			
82+55						4.5x9.5				
85+20							0.8x2.5			
85+40	85+50	10	X							
86+10						X	0.8x2.5			
89+60							0.8x2.5			
93+10						4.5x9.5				
95+20	100+18	498			ø=1.5					
100+1	103+83	365								
103+7							G-2;			
103+8						4.5x9.5				
104+8							0.8x2.5			
108+1							0.8x2.5			
108+1							0.8x2.5			
112+1							0.8x2.5			
117+1							0.8x2.5			
120+4	120+87	42			2.3x1.9					Needs
123+7							0.8x2.5			
123+8						X				
124+2						4.5x9.5				
124+5							0.8x2.5			
127+0							0.8x2.5			
128+3							0.8x2.5			
128+8						4.5x9.5				
133+6							0.8x2.5			
134+1							0.8x2.5			
137+4	137+53	8	x							
143+3							0.8x2.5			
145+7						4.5x9.5				
157+3							0.8x2.5			
158+0							0.8x2.5			
158+7							0.8x2.5			
158+7	159+20	50		X						
163+0						4.5x9.5				
166+6						4.5x9.5				
168+3	168+52	19			ø =2.5					Needs
168+5	188+00	1948								
181+0							0.8x2.5			
184+6							0.8x2.5			
188+0	209+85	2185								
192+5							0.8x2.5			
193+4						4.5x9.5				
196+7							0.8x2.5			
199+1							X			
204+1						4.5x9.5				
209+4										
209+8	209+98	12.9	7.1x2							
211+4							0.8x2.5			
211+9							0.8x2.5			
213+1									overchute	
215+2							0.8x2.5			
217+0							0.8x2.5			
220+0							0.8x2.5			
220+4							0.8x2.5			
226+0							0.8x2.5			
229+6	230+17	56	4.0x1.16							SesakeTebeli
234+1						4.0x9.0				

Attachment 5: List of main drawings of structures on Tiriponi irrigation system

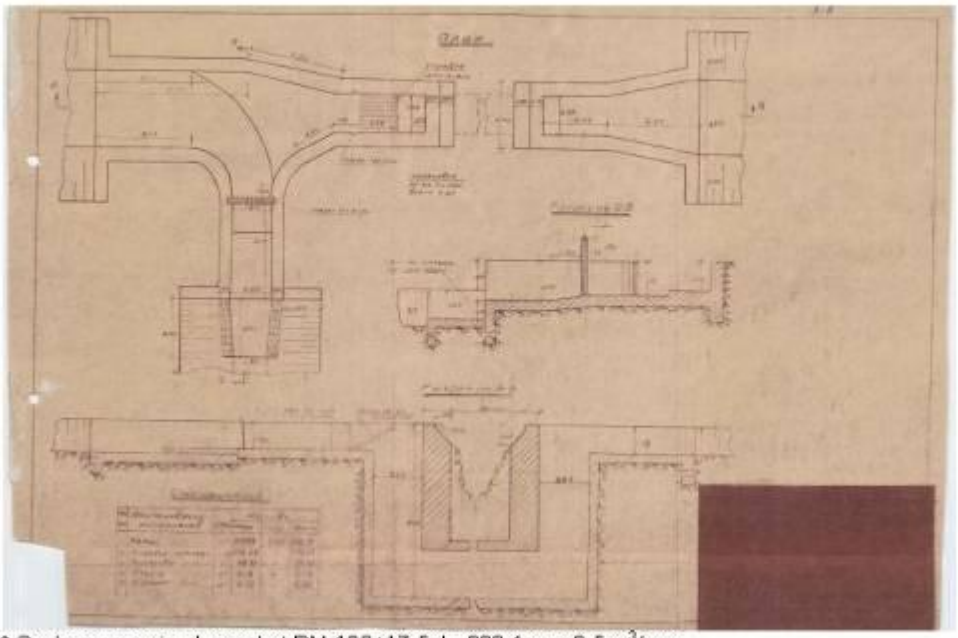
№	Description of drawings	Passport №	Scanning №
1	Aqueduct on main channel at DM 137+47,2; q=6,3-6,6 m^3/sec	121	10
2	Syphon on main channel at DM 392+60, L=18m	116	9
3	Syphon on main channel at DM 100+17,5; L=308,4m q=6,5 m^3/sec	117	8
4	L=41a. Syphon on old section of main channel at DM 280+60, L=41m	114	7
5	Syphon on main channel at DM 261+94, L=232m	113	6
6	Bridge on main channel at DM 49+91,5	40	5
7	Syphon on main channel at DM 53+99, L=19m	107	4
8	Syphon on main channel at DM 125+54,4, L=27m;	111	3
9	Syphon on main channel at DM 118+30, L=22.15m	110	2
10	Syphon with spillway on main channel at DM 174+22, L=19,3	112	1
11	Flume on main channel at DM 289+93; q=5 m^3/sec, L=23,15m	130	15
12	Aqueduct on main channel at DM 229+61; q=5 m^3/sec, L=56m	128	14
13	Aqueduct on main channel at DM 203+85.5; q=6 m^3/sec, L=27m	127	13
14	Flume for removing surface water on main channel at Mlashe gorge; L=17,9 m	122	11
15	Flume for removing surface water on main channel at Chkareula gorge; L=17,9 m	123	12
16	Flume on main channel at DM 266+62, L=22,15 m	129	19
17	Aqueduct on main channel at DM 332+00; q=2,5 m^3/sec, L=13,7m	132	18
18	Flume on main channel at DM 295+17; q=4 m^3/sec, L=18m	131	17
19	Syphon on old section of channel at DM 348+35, L=30m	115	16



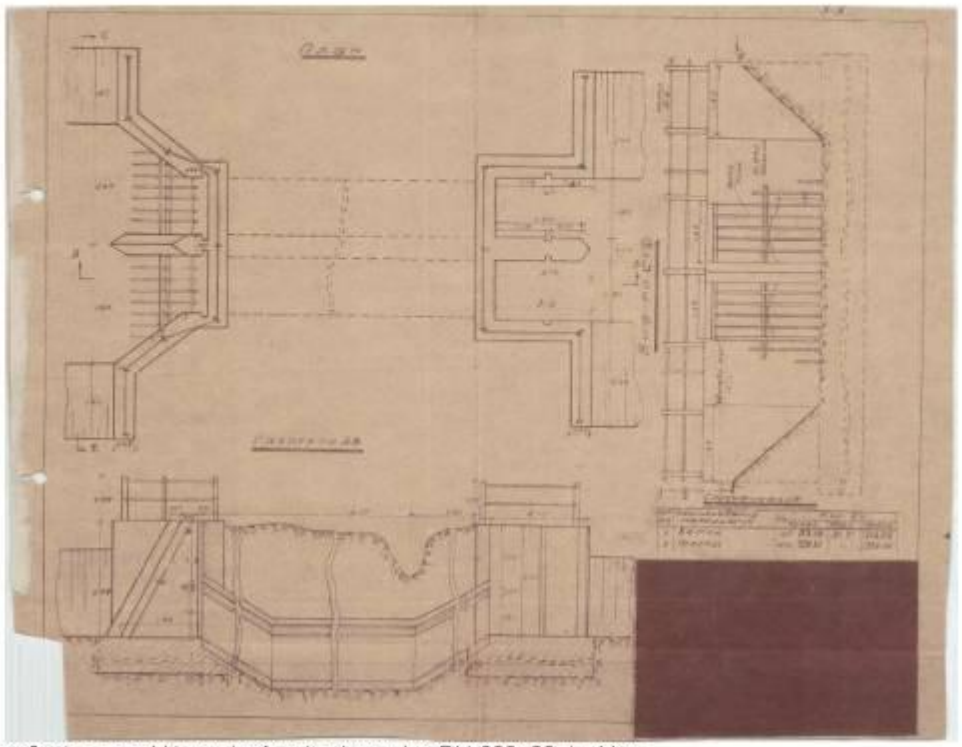
1. Aqueduct on main channel at DM 137+47, 2; q=6, 3-6, 6 m^3/sec;



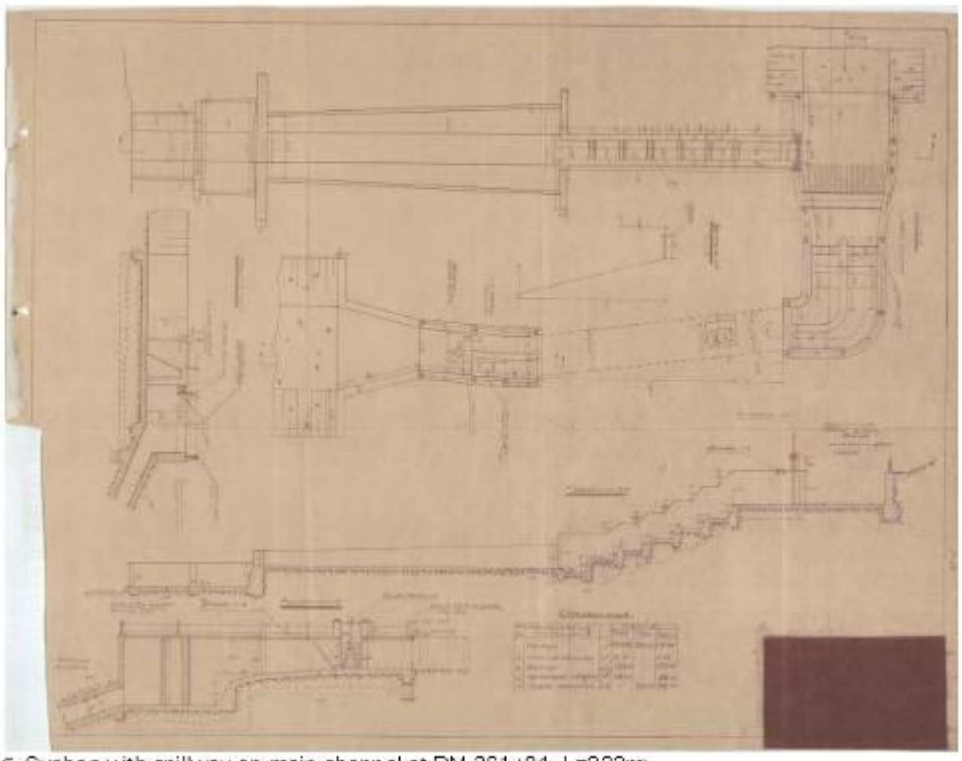
2. Syphon on main channel at DM 392+60, L=18m;



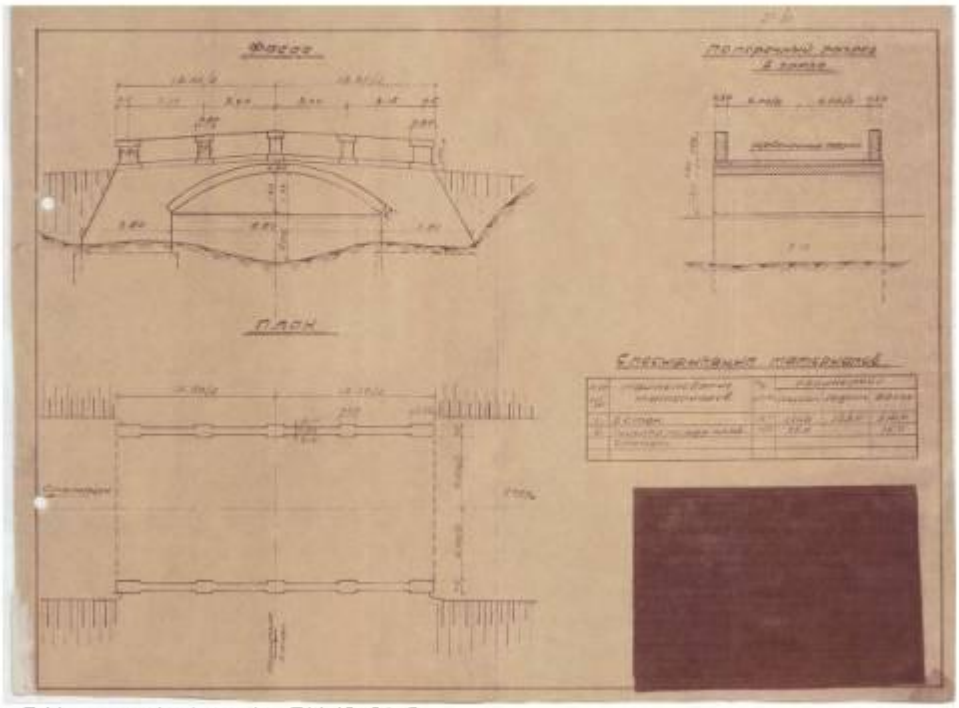
3.Syphon on main channel at DM 100+17,5; L=308,4m q=6,5 m^3/sec;



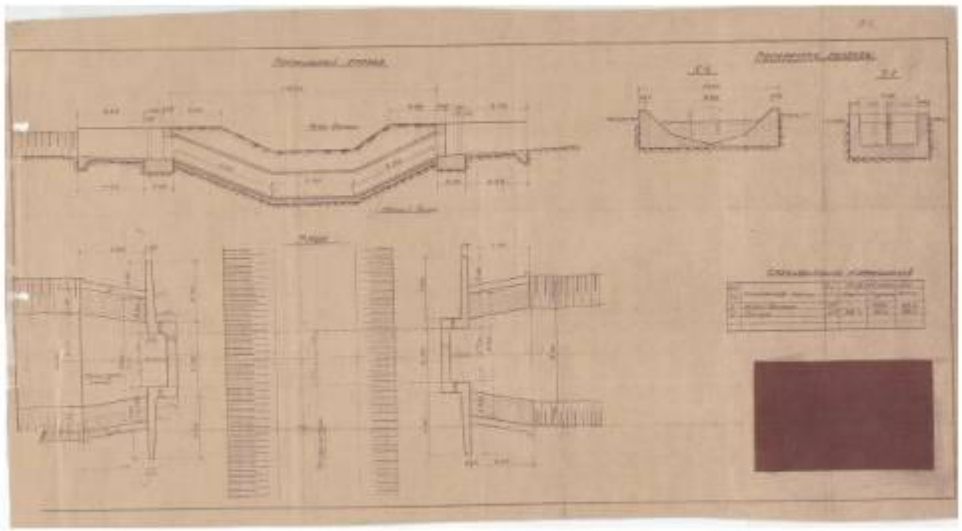
4. Syphon on old branch of main channel at DM 280+60, L=41m;



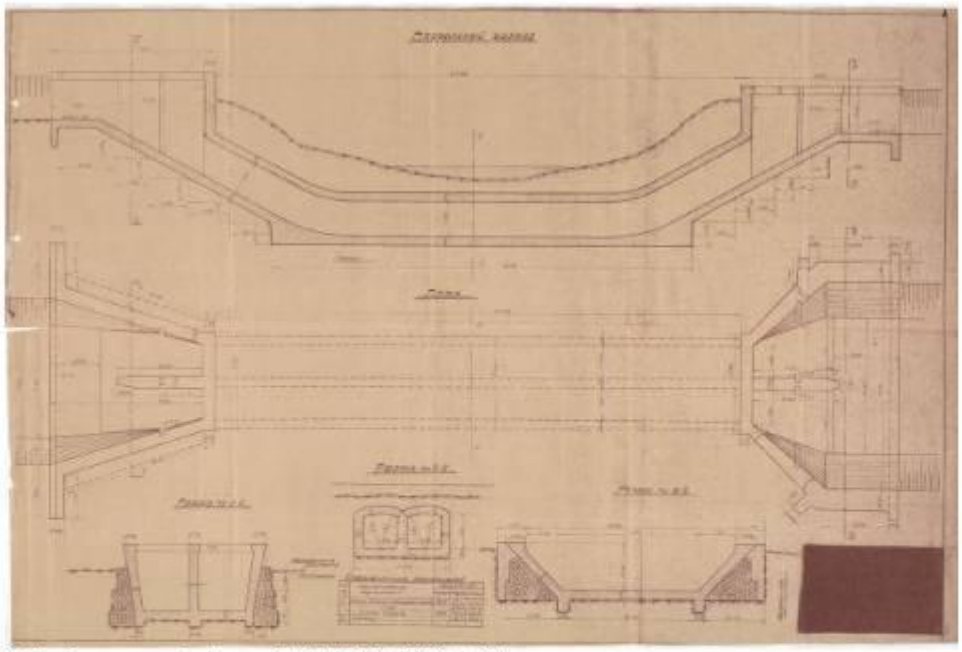
5. Syphon with spillway on main channel at DM 261+84; L=232m;



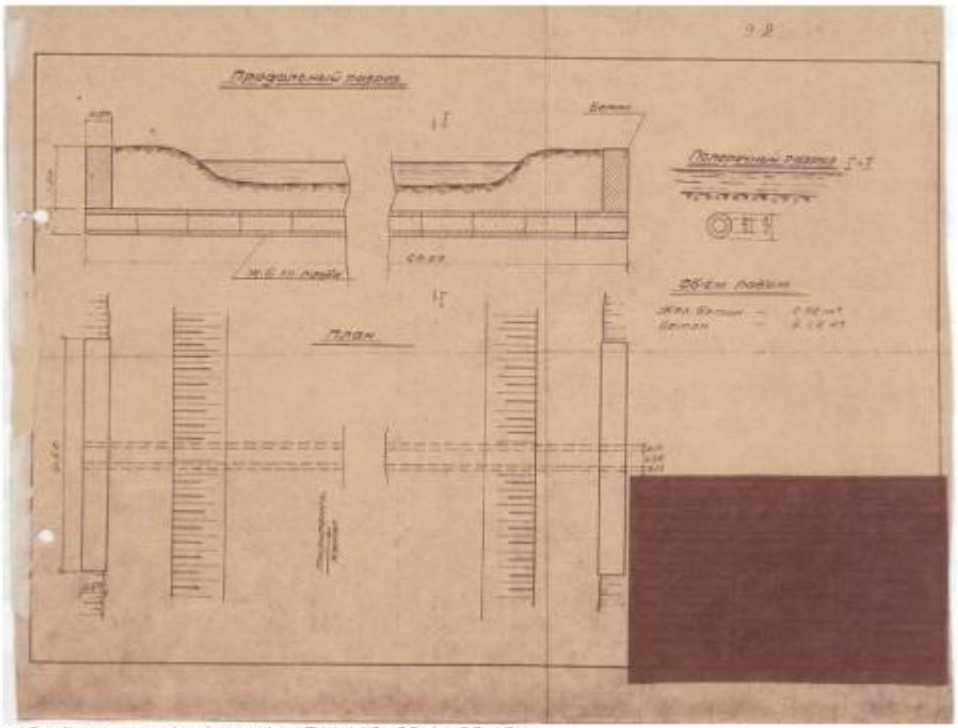
6. Bridge on main channel at DM 49+91, 5;



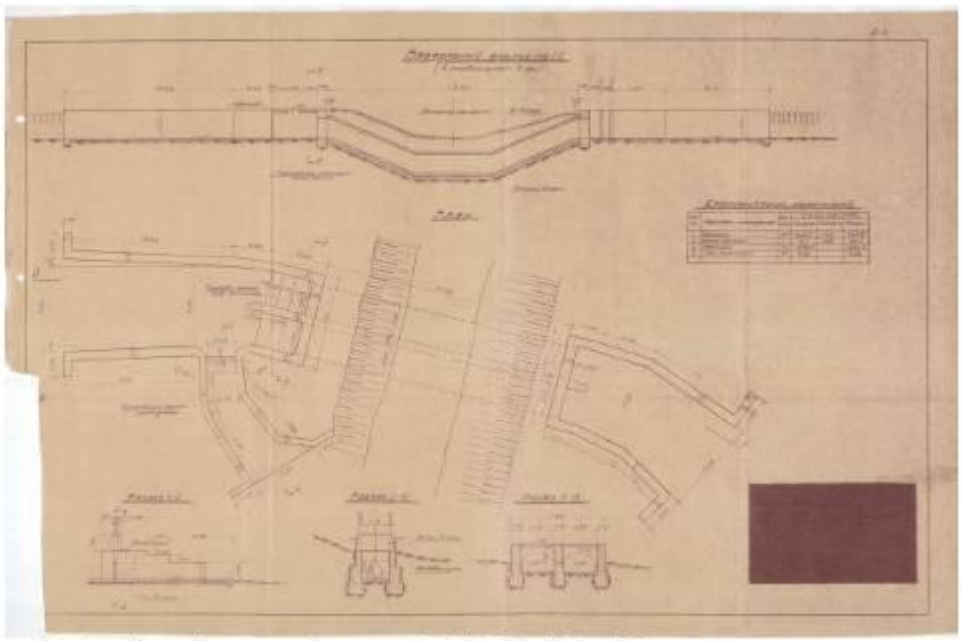
7. Syphon on main channel at DM 53+99, L=19m;



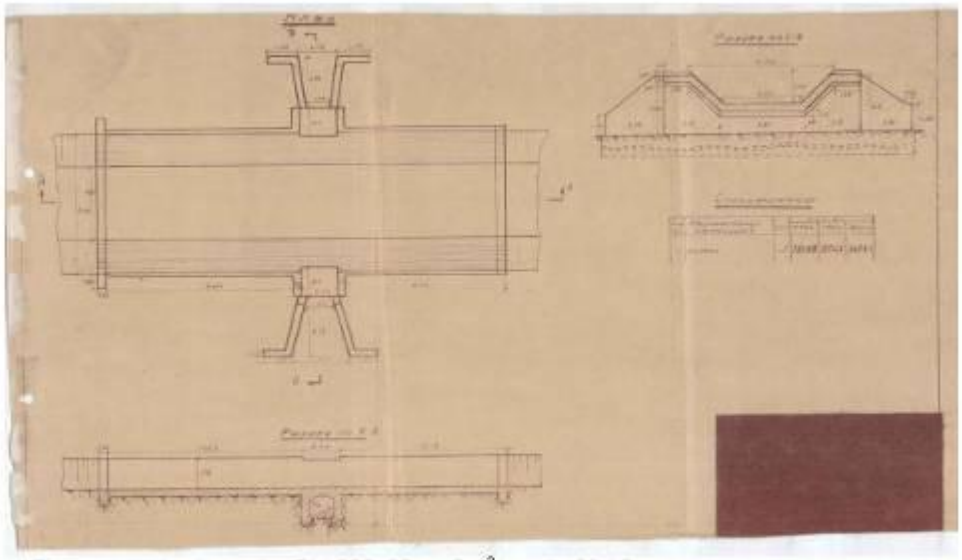
8. Syphon on main channel at DM 125+54, 4; L=27m;



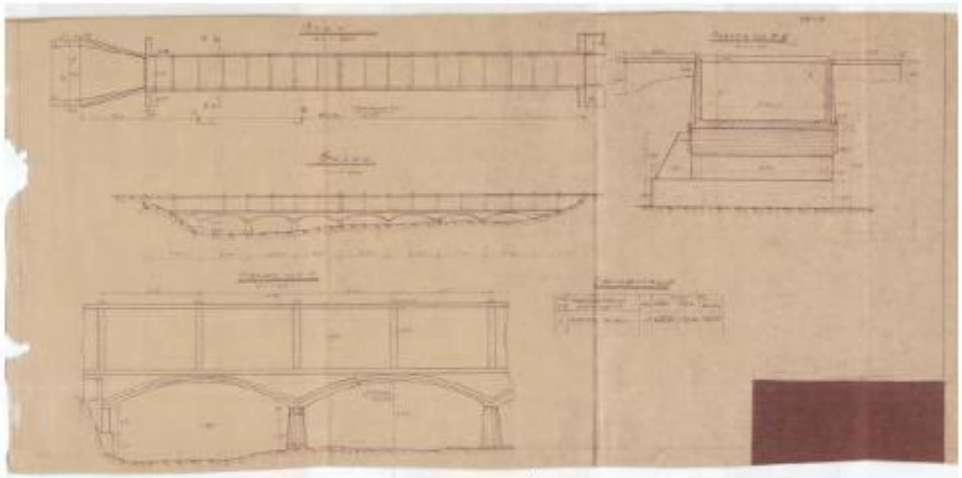
9. Syphon on main channel at DM 118+30, L=22.15m;



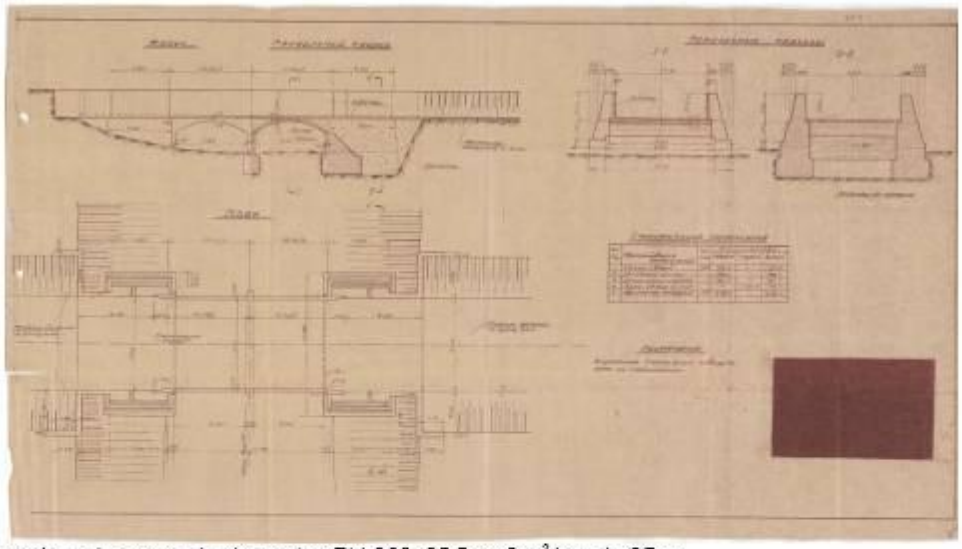
10. Syphon with spillway on main channel at DM 174+22, L=19,3;



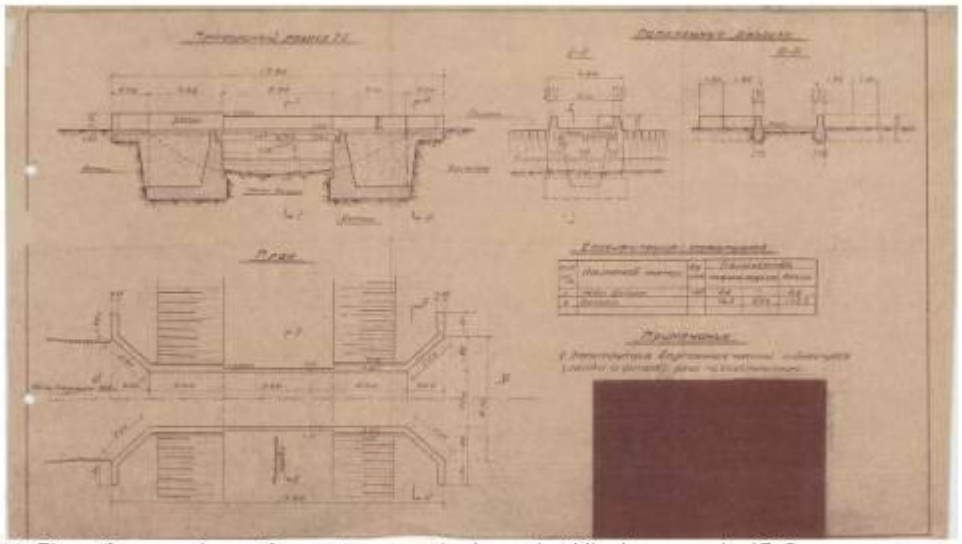
11. Flume on main channel at DM 289+93; q=5 m^3/sec; L=23,15m;



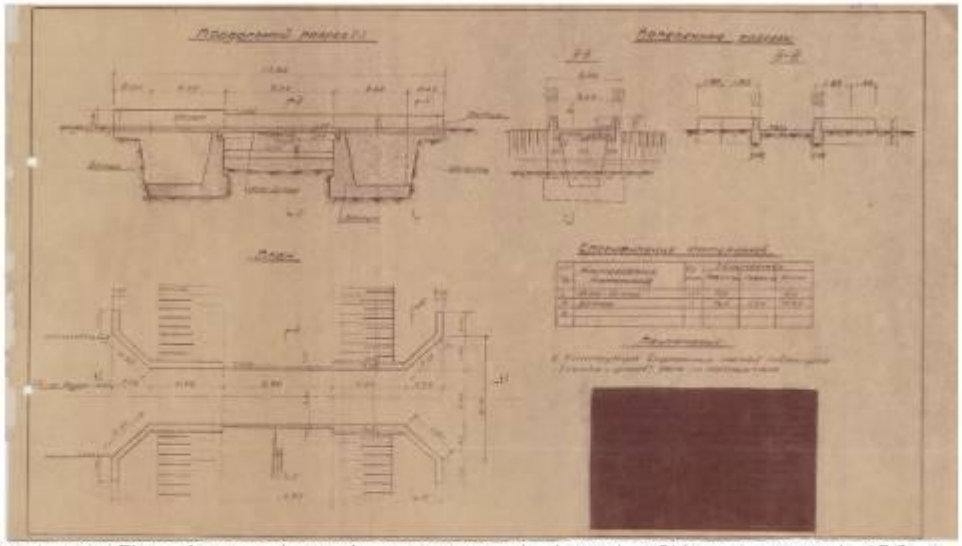
12. Aqueduct on main channel at DM 229+61; q=5 m^3/sec, L=56m;



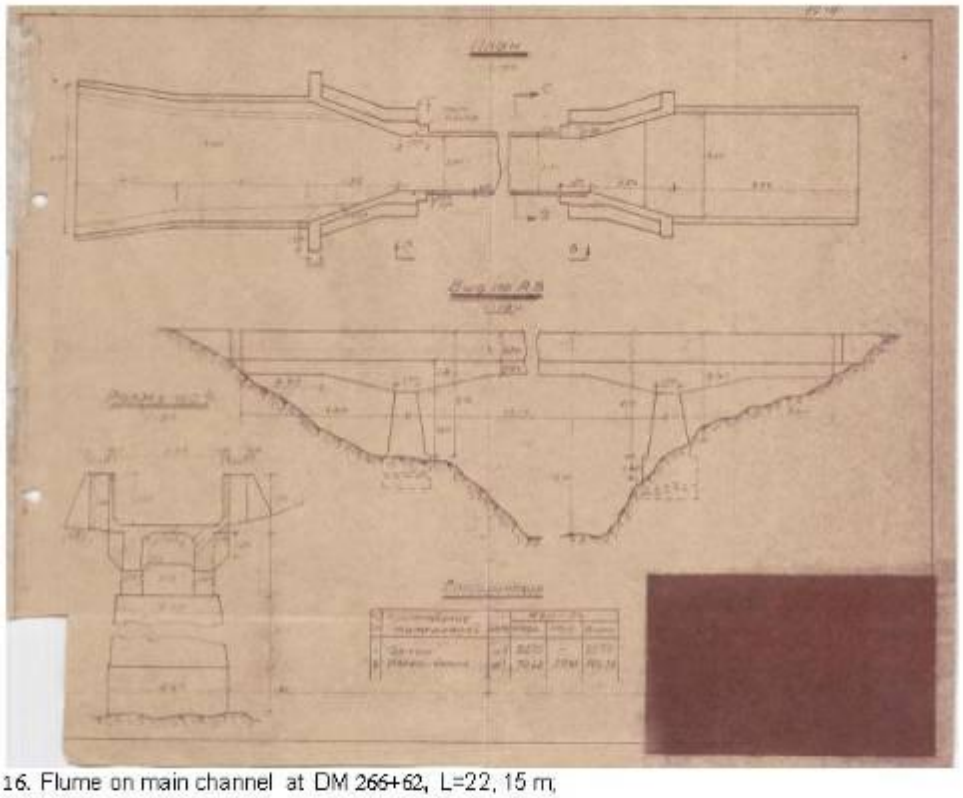
13. Aqueduct on main channel at DM 203+85.5; q=6 m^3/sec, L=27m;



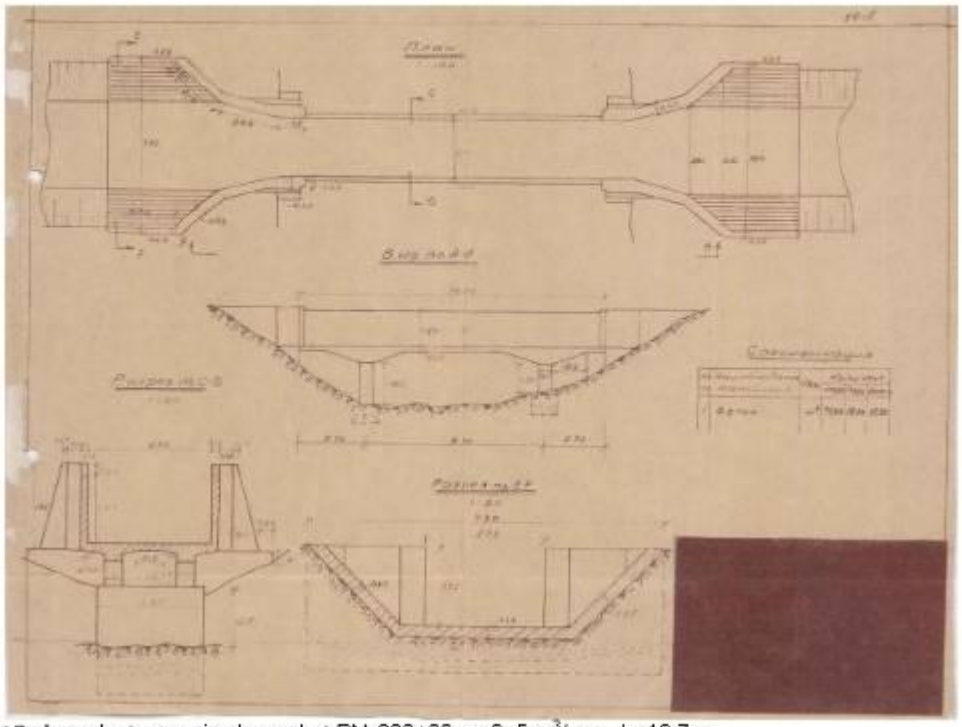
14. Flume for removing surface water on main channel at Mlashe gorge; L=17, 9 m;



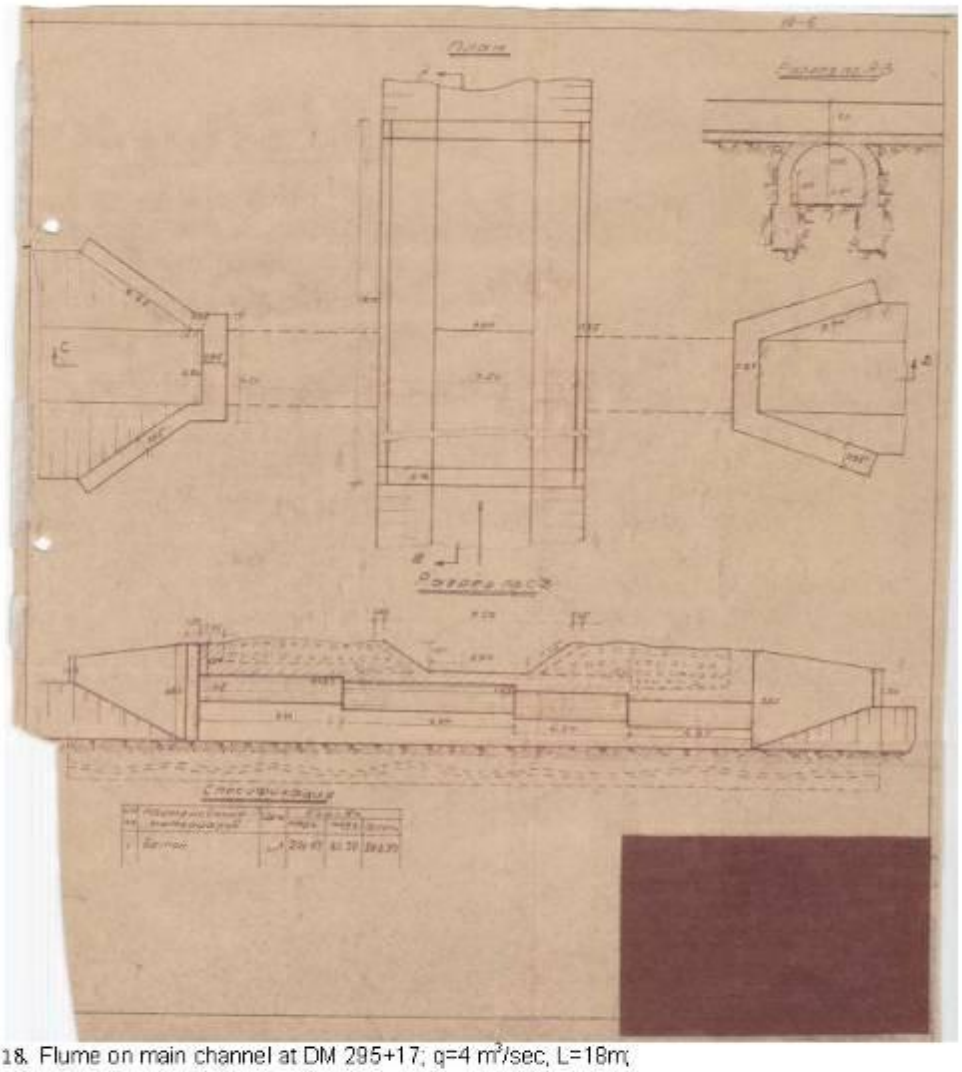
15. L=17.99 Flume for removing surface water on main channel at Chkareula gorge; L=17,9 m;



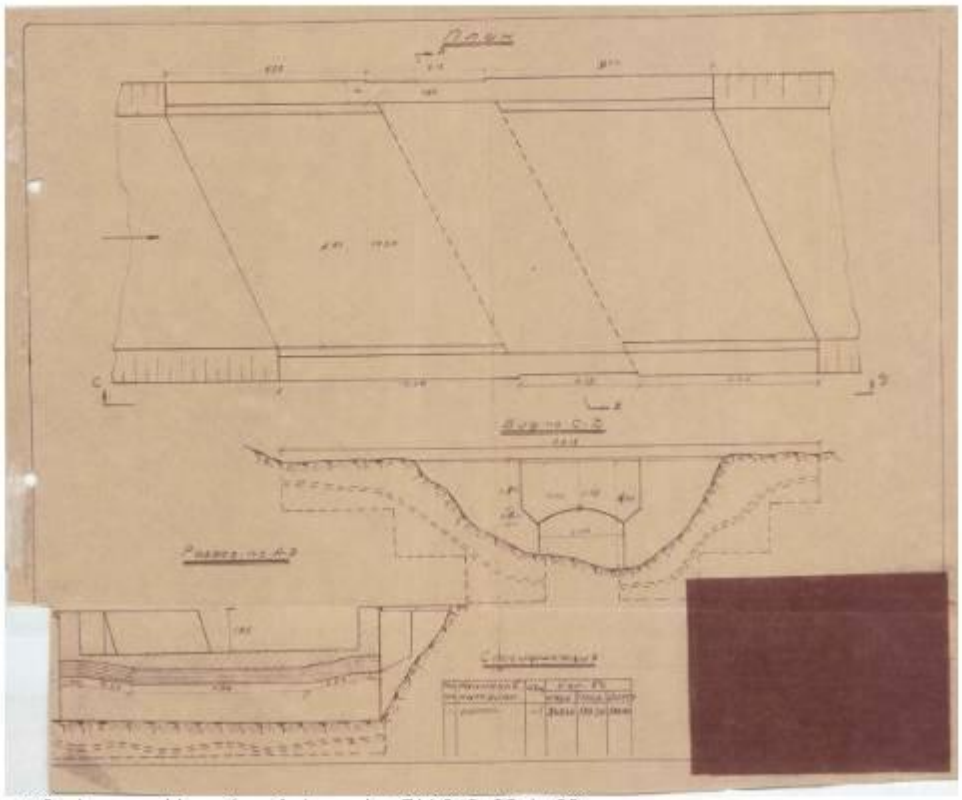
16. Flume on main channel at DM 266+62, L=22, 15 m;



17. Aqueduct on main channel at DM 332+00; q=2, 5 m^3/sec, L=13,7m;

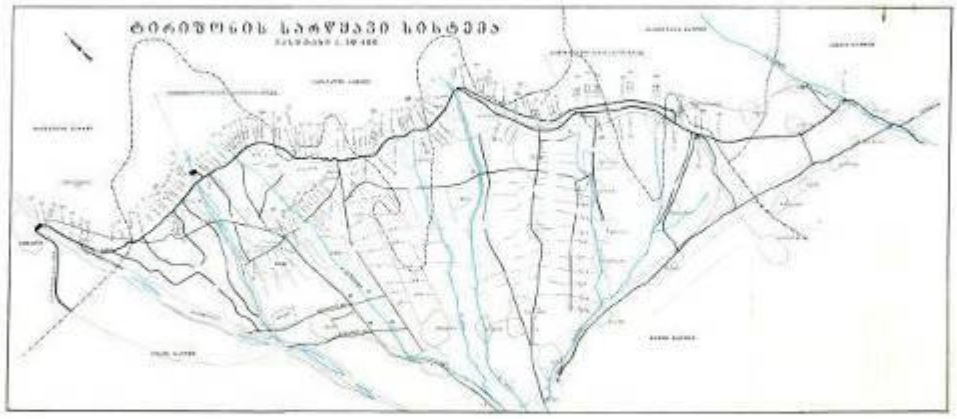


18. Flume on main channel at DM 295+17; q=4 m^3/sec, L=18m;



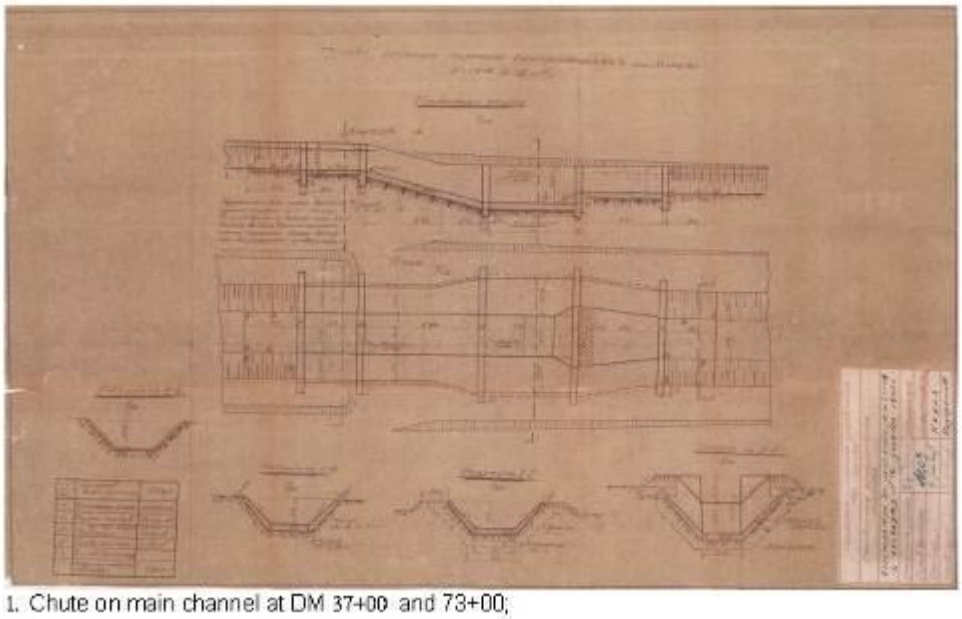
19. Syphon on old section of channel at DM 348+35, L=30m.

Tiriponi Irrigation scheme

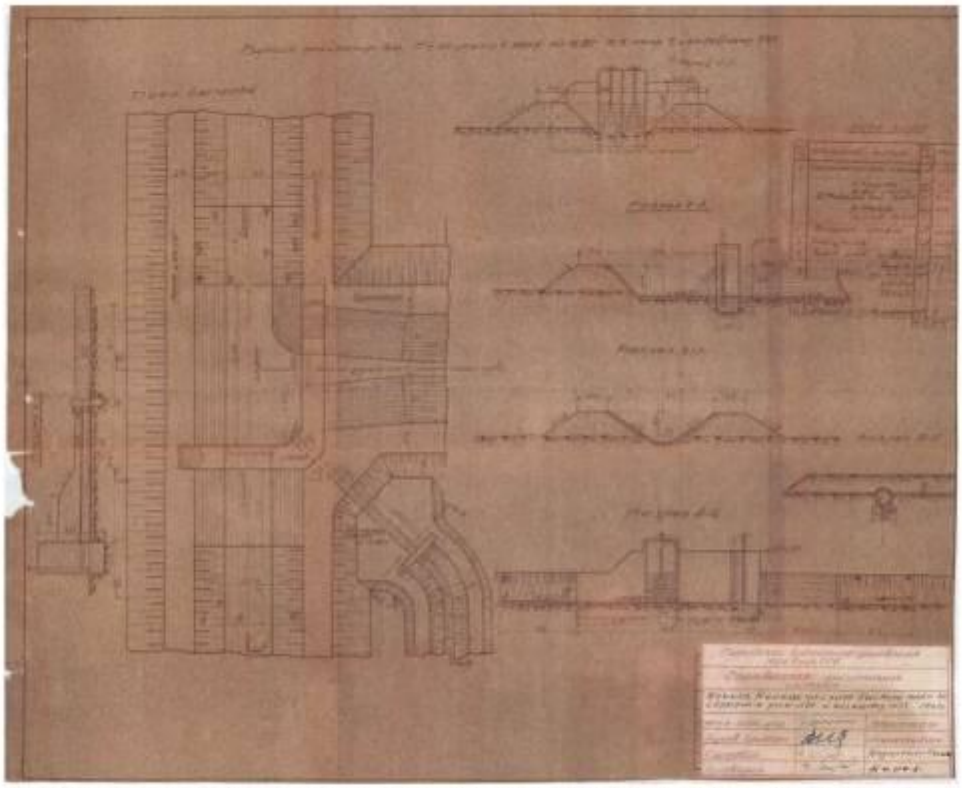


Attachment 6: List of main drawings of structures on Saltvisi irrigation system

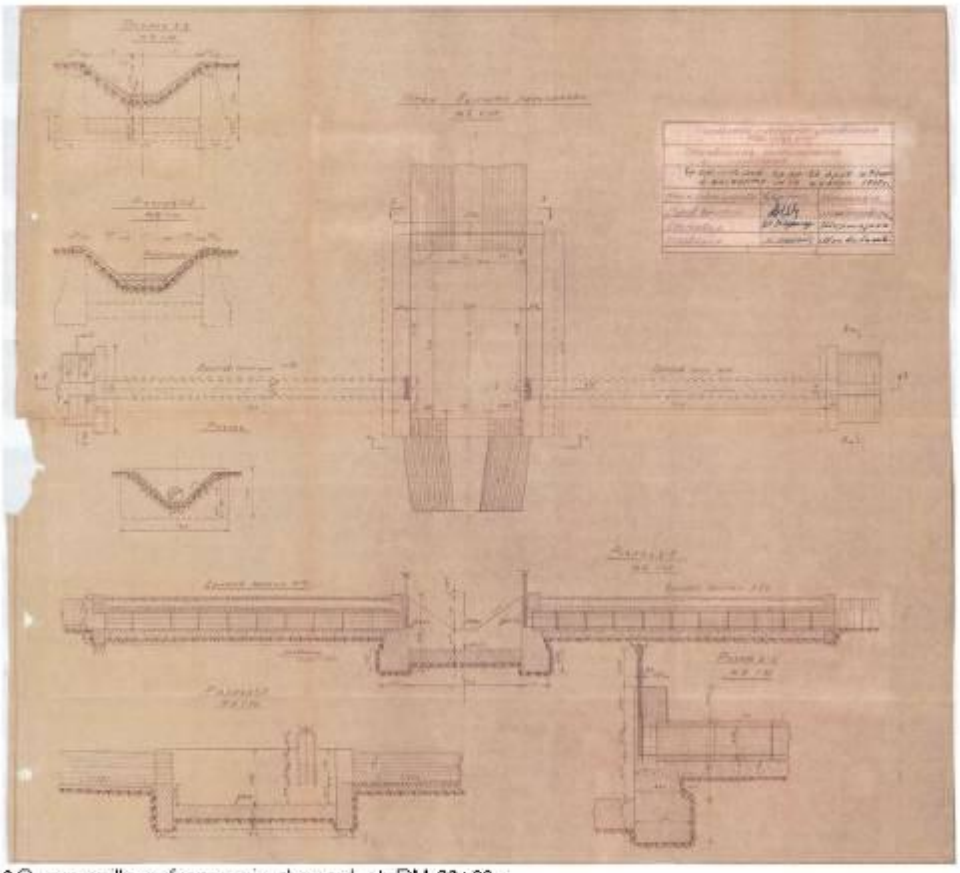
№	Description of drawings	Passport №	Scanning №
1	Chute on main channel at DM 37+00 and 73+00	14	24
2	Initial section of Khelqtseuli chute on main channel at DM 86+00 with spillway and outlet	15	23
3	Group spillway from main channel at DM 92+00	16	22
4	Bridge on main channel at DM 96+00	17	21
5	Outlet from main channel at 10+80	18	20
6	Group spillway from main channel at DM 106+80	19	19
7	Bridge on the main channel at DM 106+45	20	18
8	Group spillway from main channel at DM 120+75	21	17
9	Bridge on the main channel at DM 124+90	2	16
10	23 | 15		
11	Group spillway from main channel at DM 129+00	24	14
12	Distribution G-1on lower channel DM 49+50	26	13
13	Khelqtseuli chute with spillway at DM 137+60	25	12
14	Bridge on main channel at DM 138+50	26	11
15	Last section of Khelqtseuli chute at DM 146+60	27	10
16	Bridge on the main channel at DM 50+00	13	9
17	Bridge on the main channel at DM 143+90	28	8
18	Group spillway from main channel at DM 148+00	29	7
19	Distribution G-1from main channel at DM 158+00	30	6
20	Pipe under the main channel at DM 158+50 for flowing surface waters	30'	5
21	Bridge on G-1 at DM 184+00	32	4
22	Bridge on G-1 at DM 170+10	31	3
23	G-2, end of main channel at DM 180+22	33	2



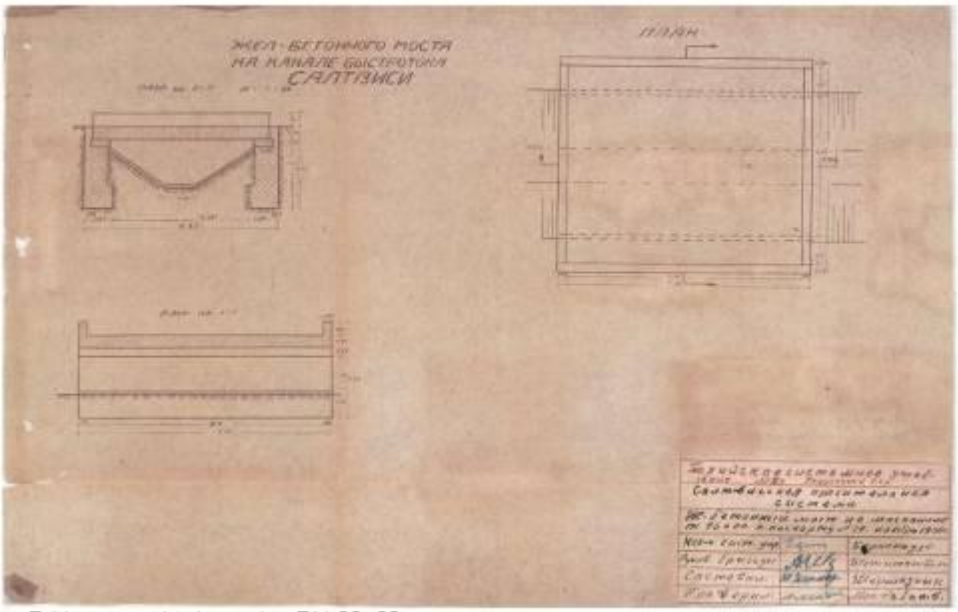
1. Chute on main channel at DM 37+00 and 73+00;



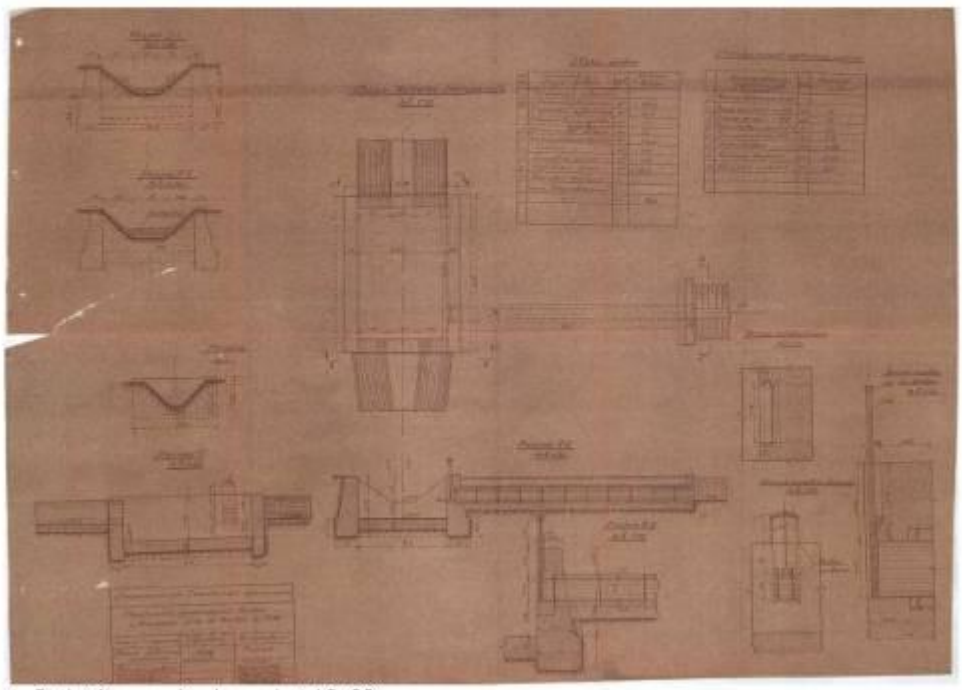
2. Initial section of Khelqtseuli chute with spillway and outlet on main channel at DM 86+00;



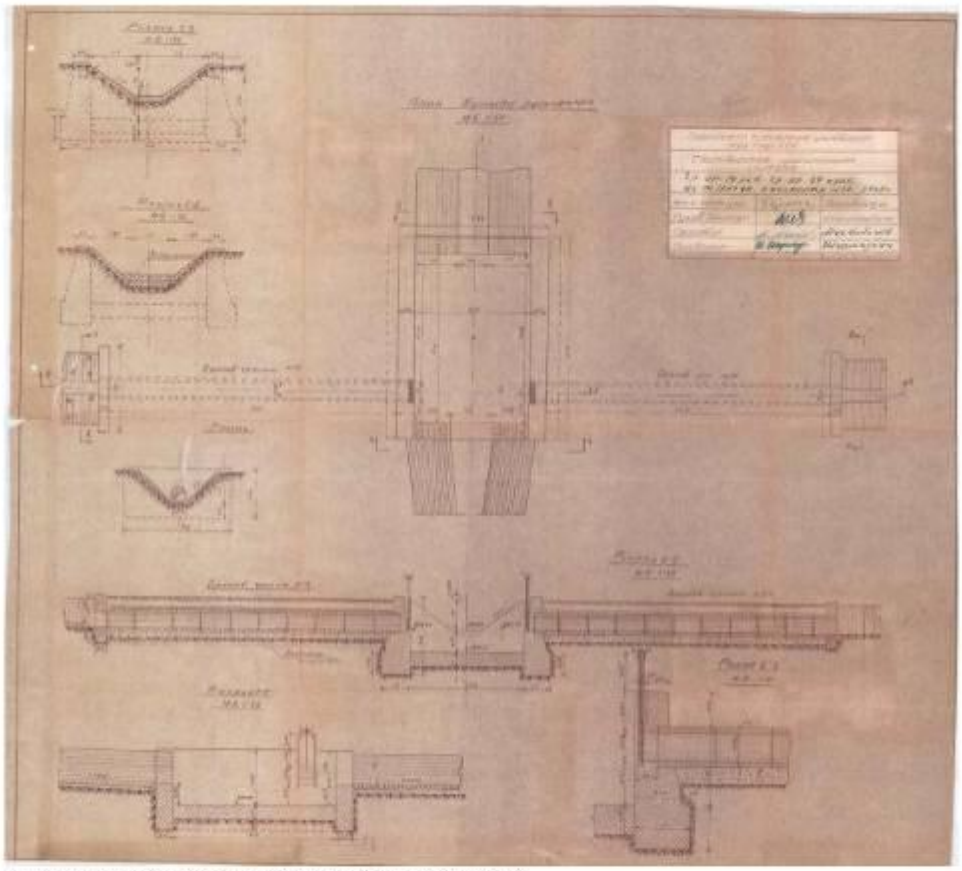
3.Group spillway from main channel at DM 92+00;



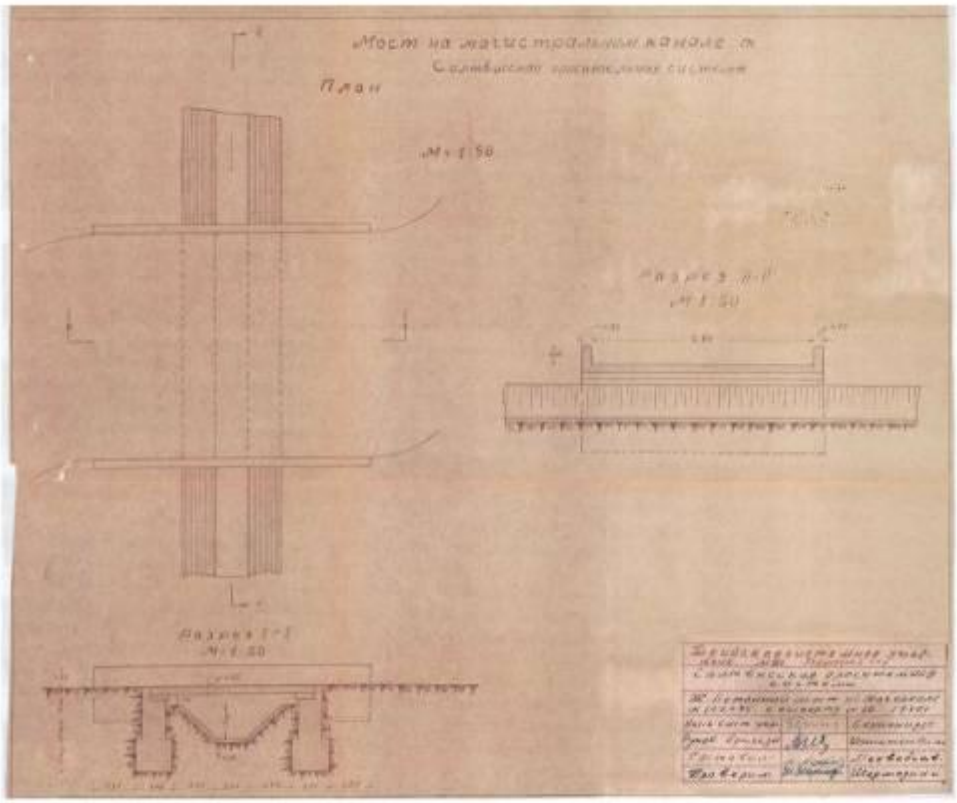
4. Bridge on main channel at DM 96+00;



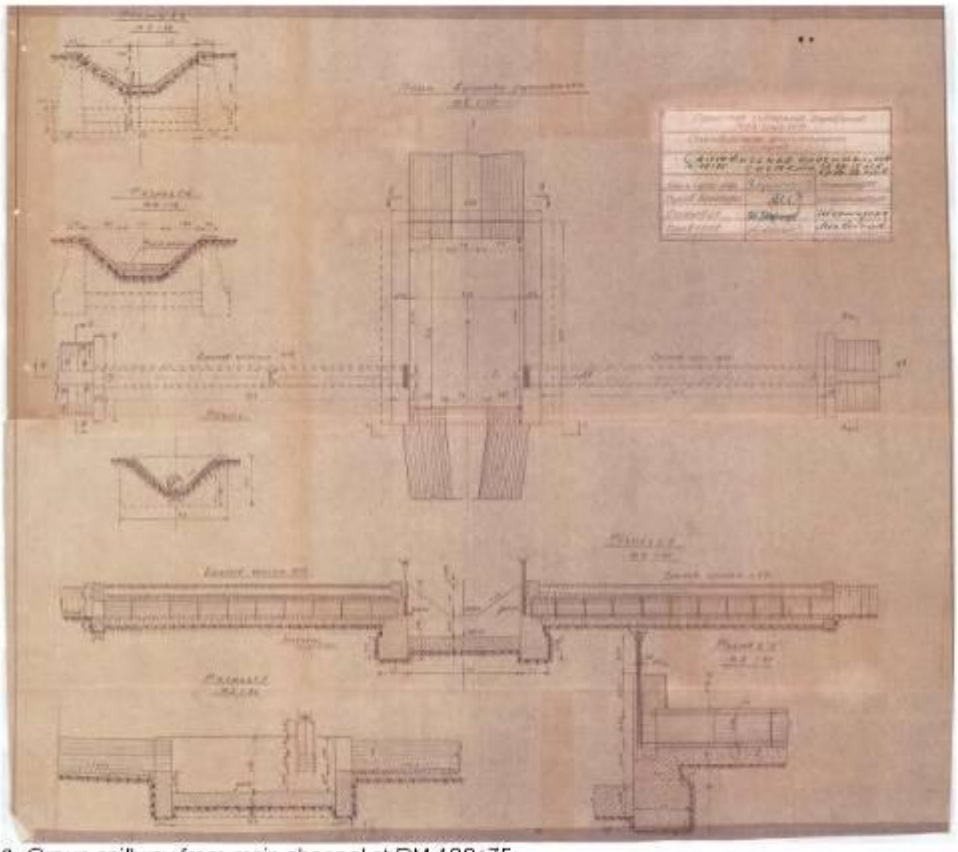
5. Outlet from main channel at 10+80;



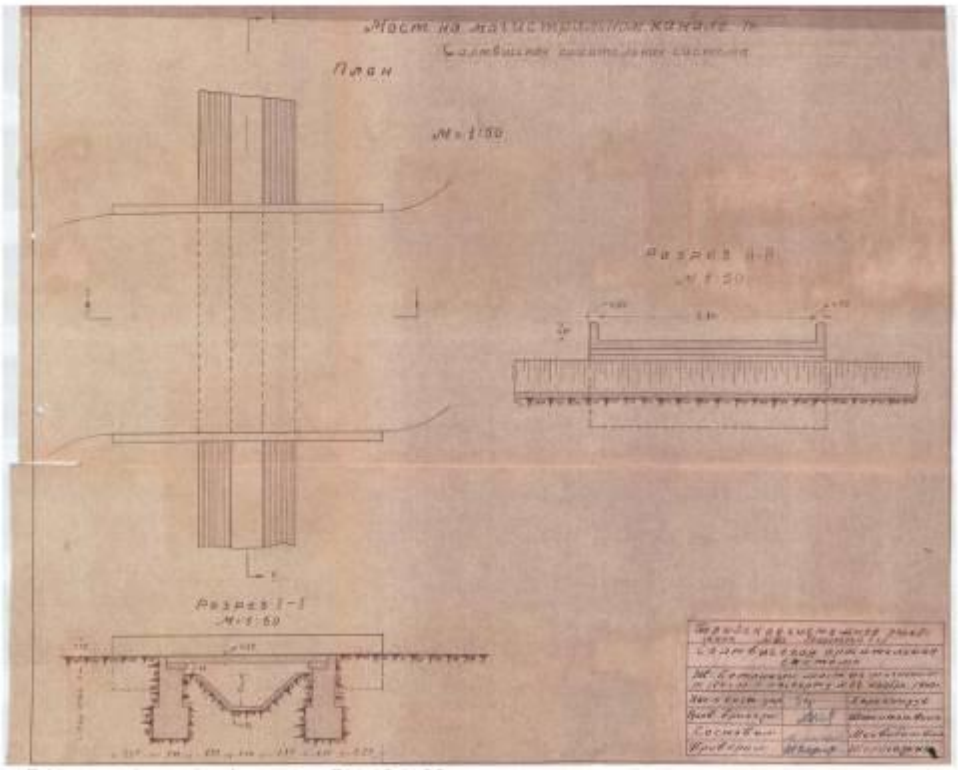
6. Group spillway from main channel at DM 106+80;



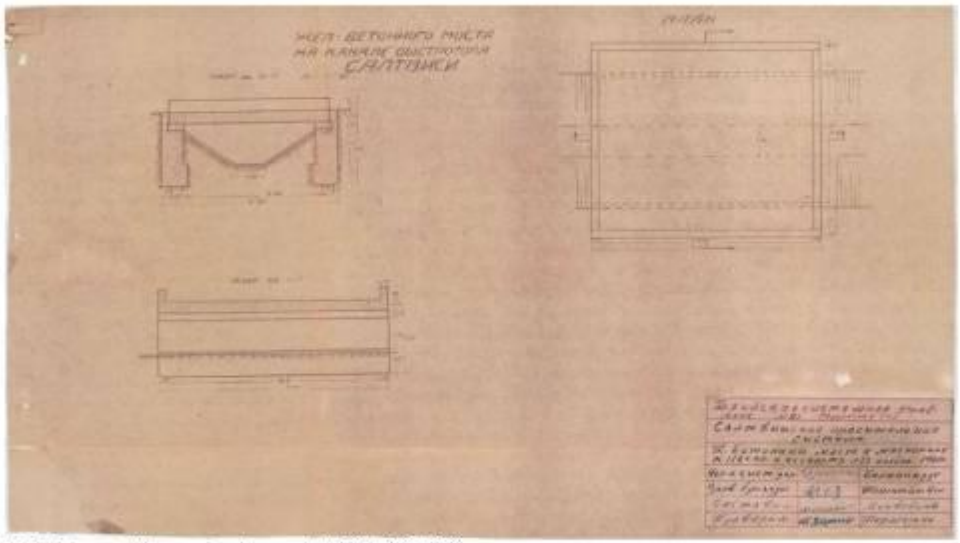
7. Bridge on the main channel at DM 106+45;



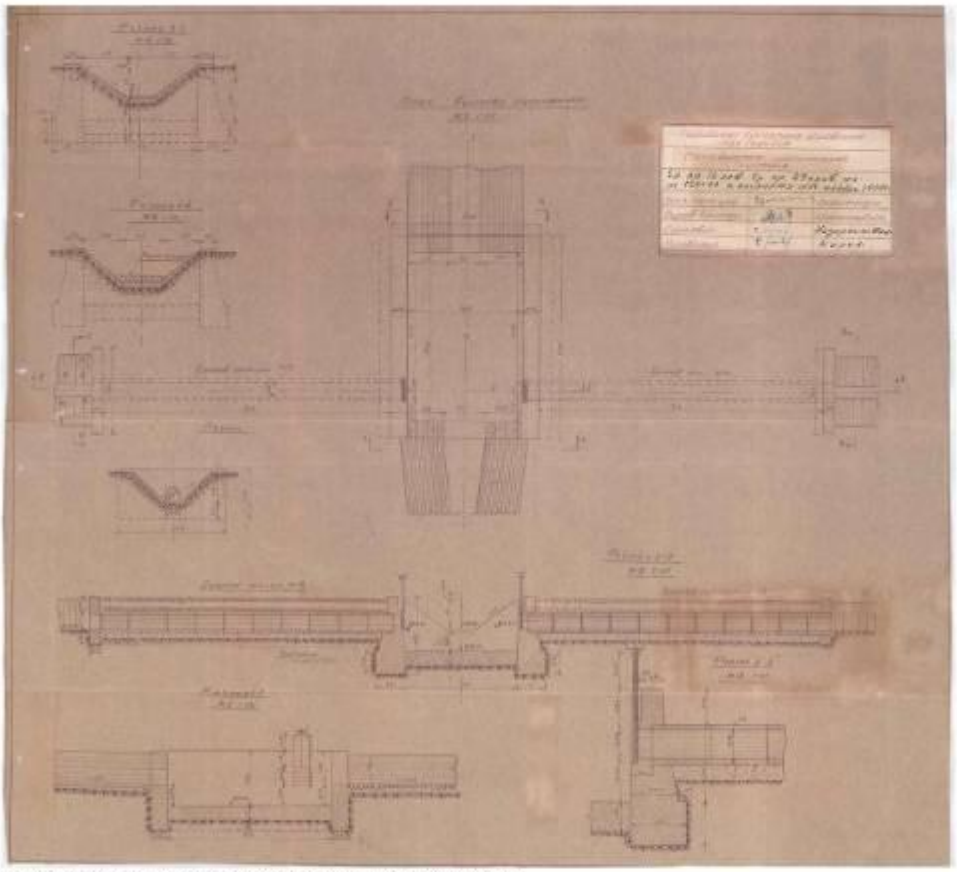
8. Group spillway from main channel at DM 120+75;



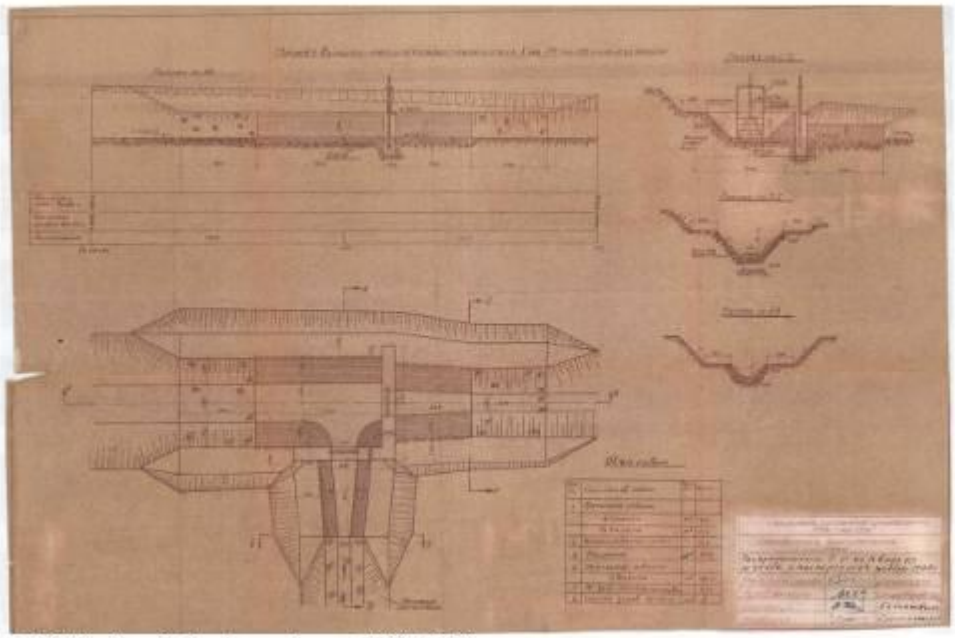
9. Bridge on the main channel at DM 124+90;



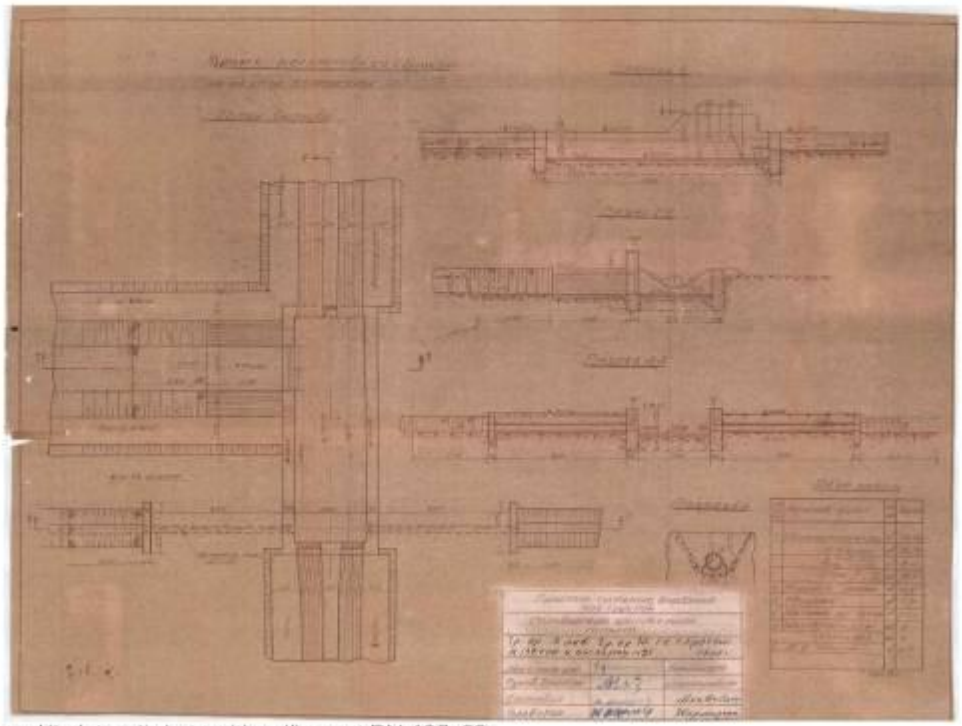
10. Bridge on the main channel at DM 128+90;



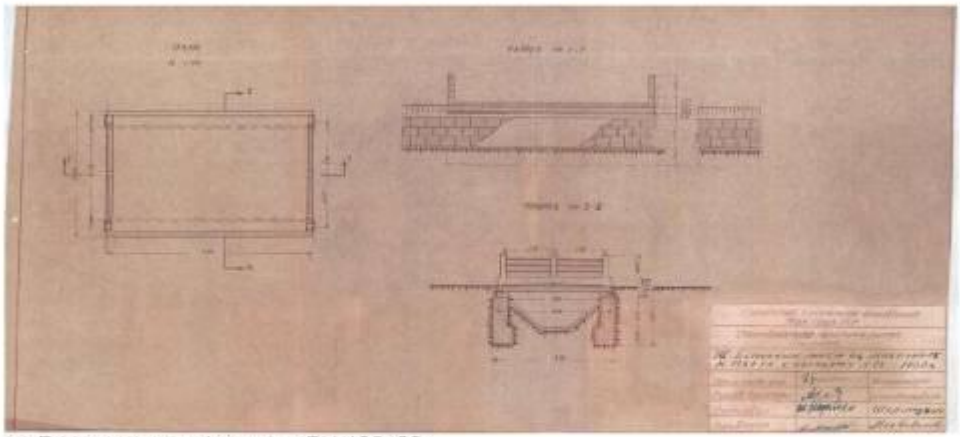
11. Group spillway from main channel at DM 129+00;



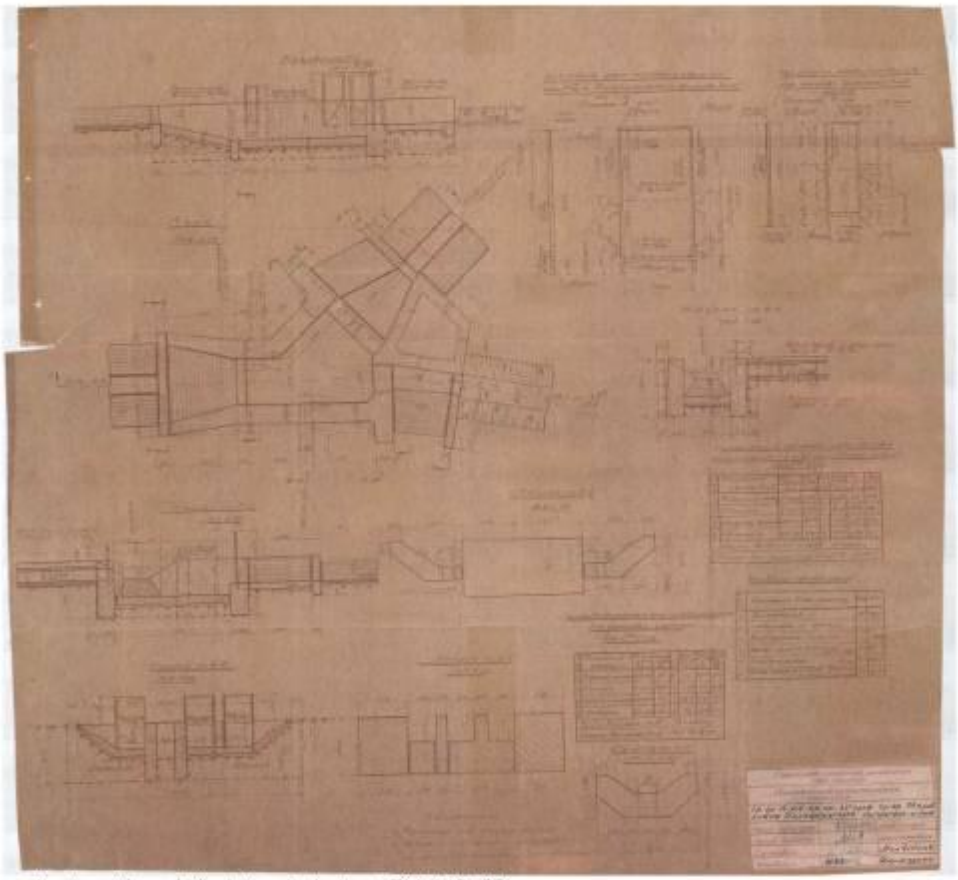
12. Distribution G-1on lower channel DM 49+50;



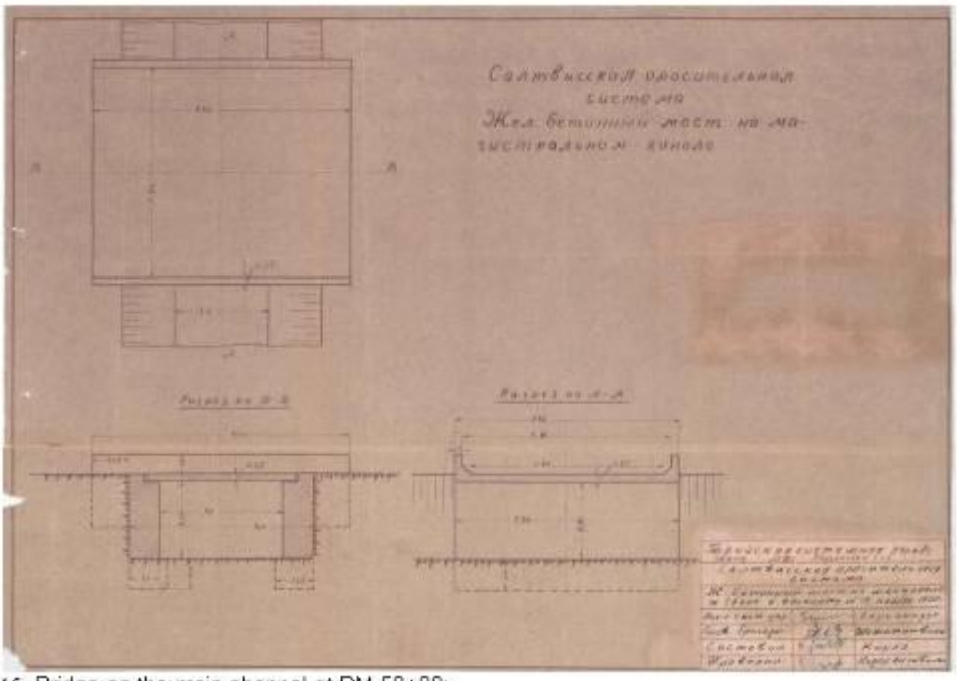
13. Khelqtseuli chute with spillway at DM 137+60;



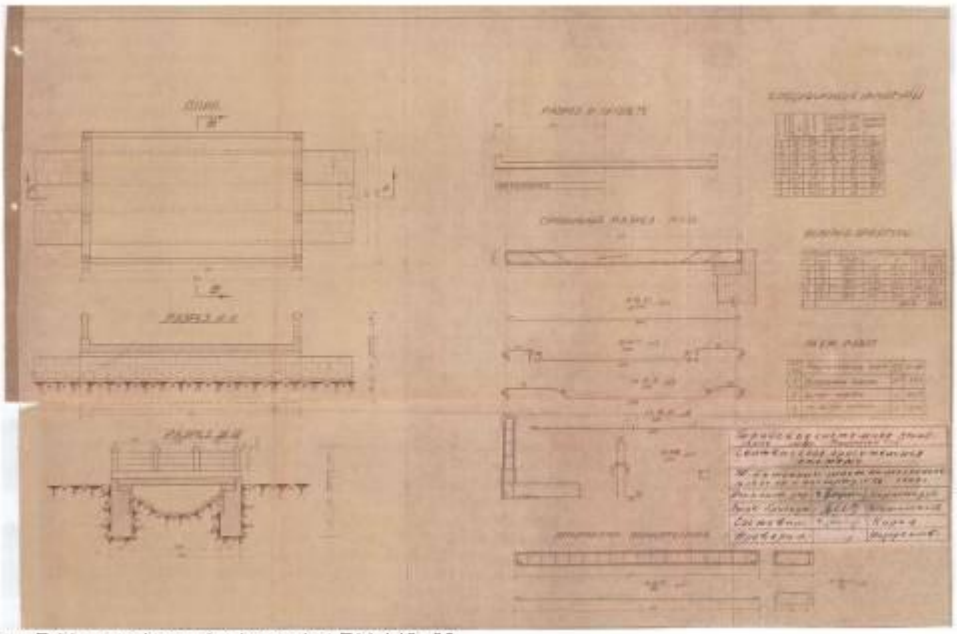
14. Bridge on main channel at DM 138+50;



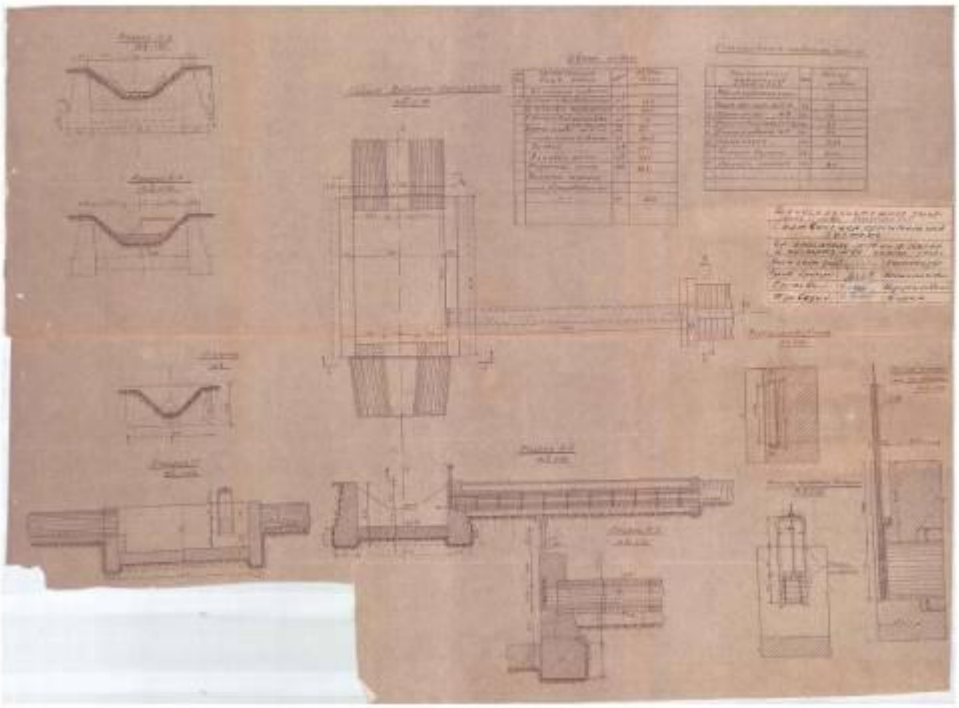
15. Last section of Khelqtseuli chute at DM 148+60;



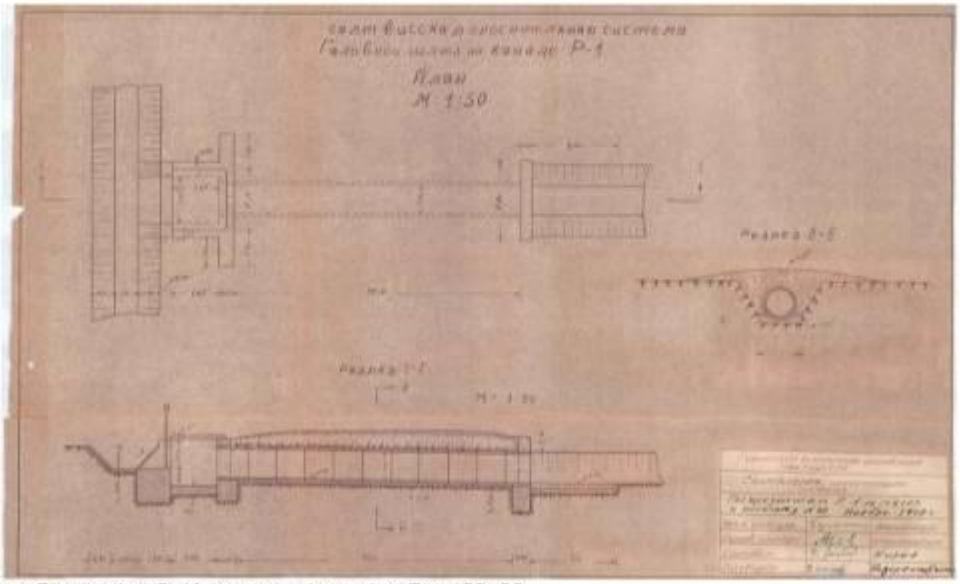
16. Bridge on the main channel at DM 50+00;



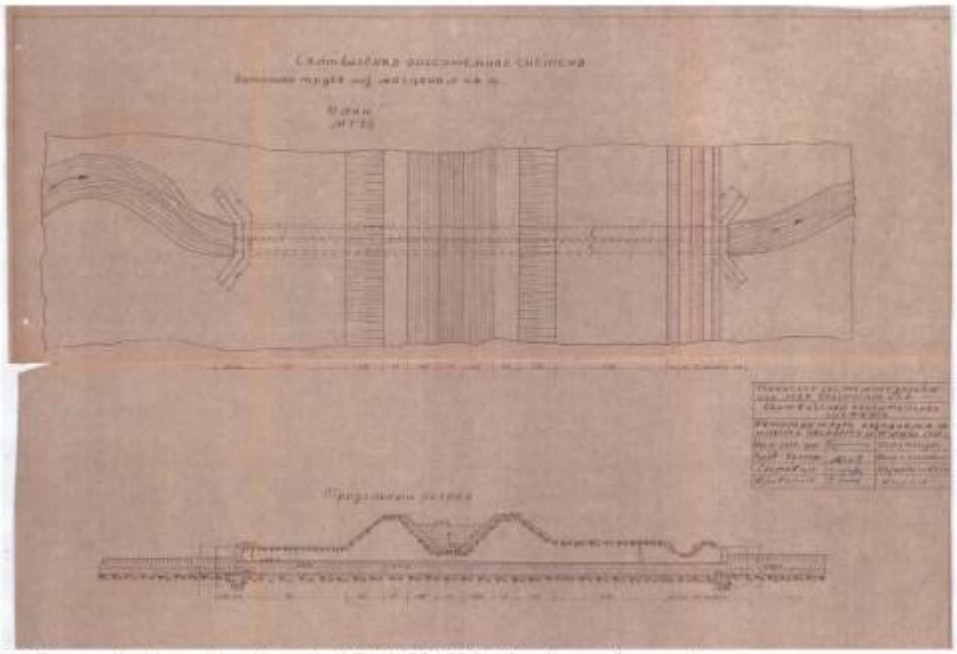
17. Bridge on the main channel at DM 143+90;



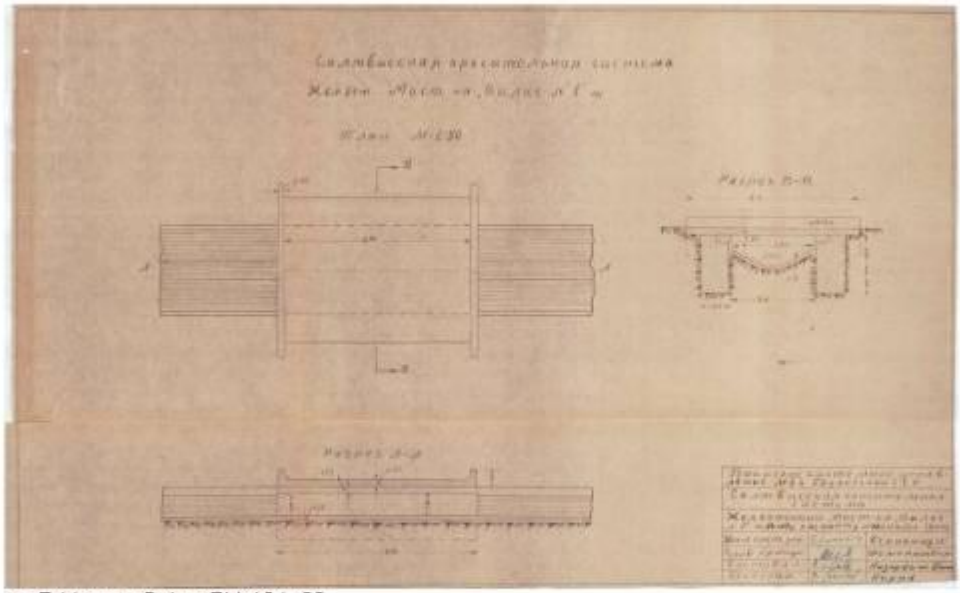
18. Group distribution unit №9 from main channel at DM 148+00;



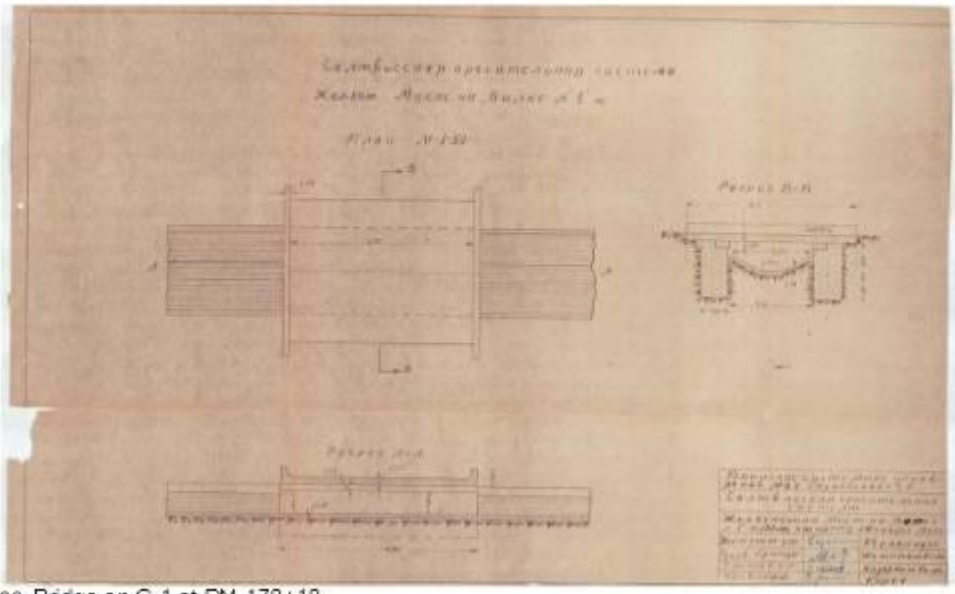
19. Distribution G-1from main channel at DM 158+00;



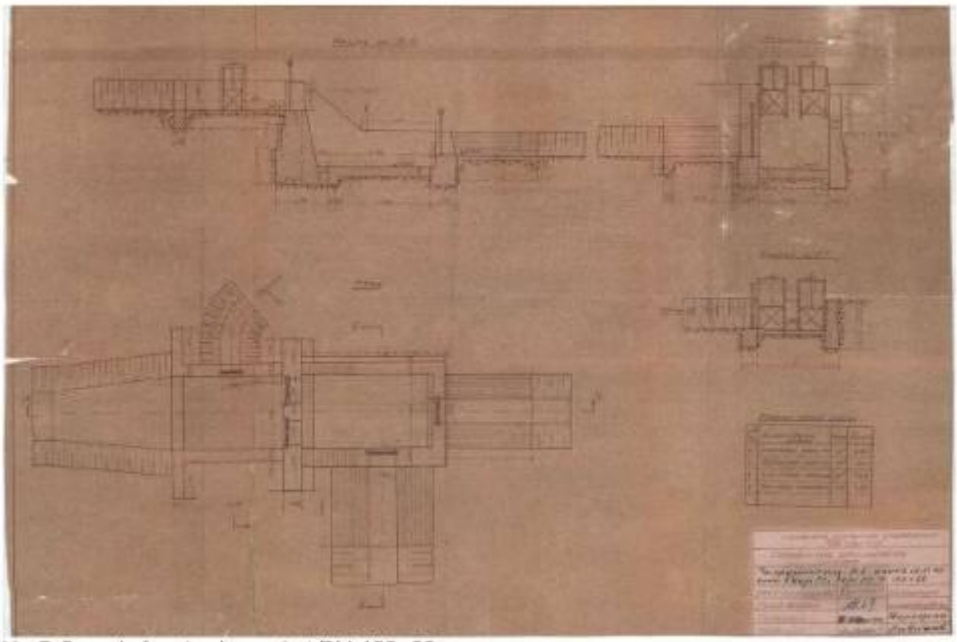
20. Pipe under the main channel at DM 158+50 for flowing surface waters;



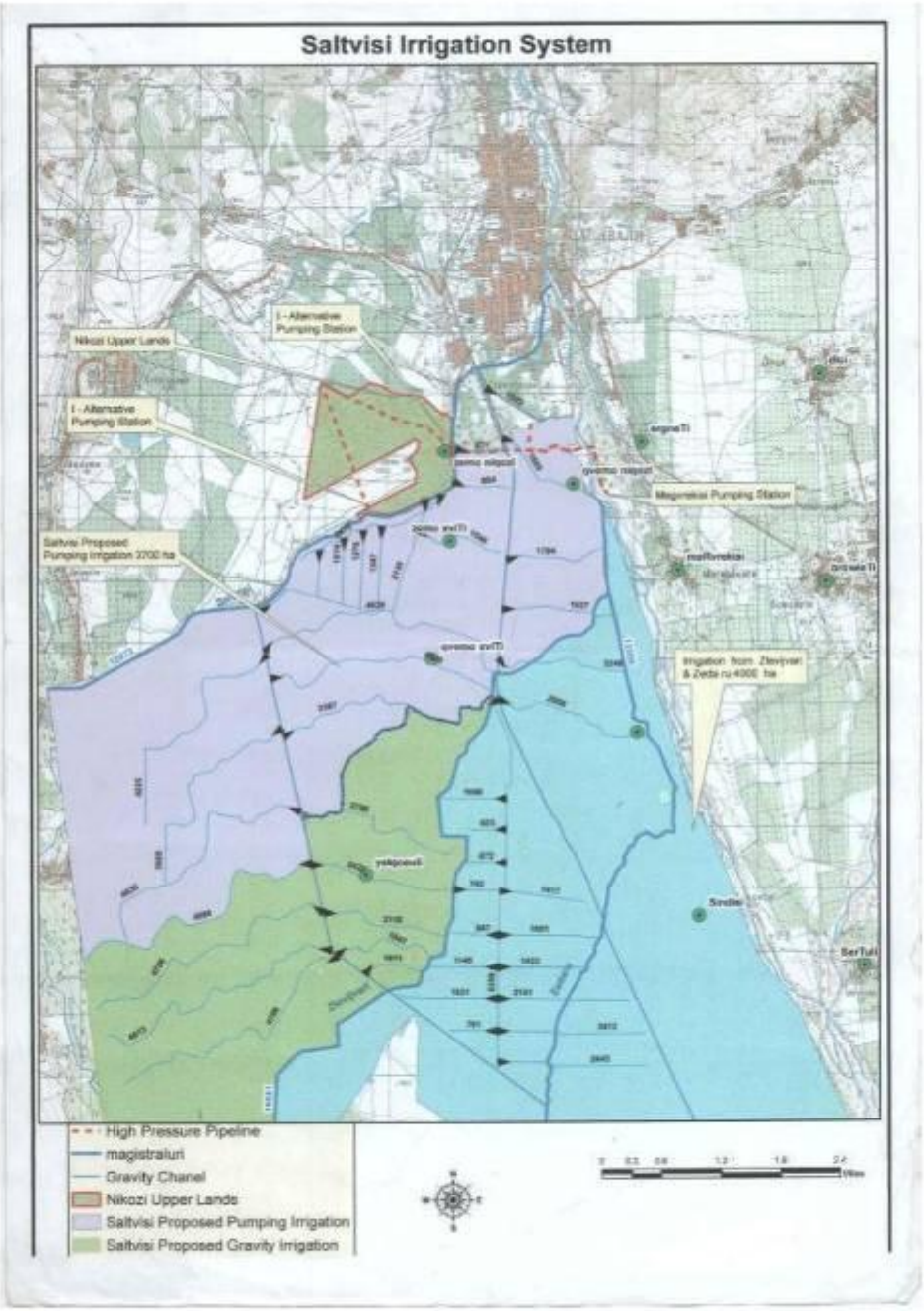
21. Bridge on G-1 at DM 184+00



22. Bridge on G-1 at DM 170+10



23. G-2, end of main channel at DM 180+22 ss


Saltvisi Irrigation System
I - Alternative Pumping Station
Nikozi Upper Lands
I - Alternative Pumping Station
Megvrekisi Pumping Station
Saltvisi Proposed Pumping Irrigation 2700 ha
Irrigation from Zhevjvari & Zeda ru 4000 ha
Sindisi
High Pressure Pipeline
magistraluri
Gravity Chanel
Nikozi Upper Lands
Saltvisi Proposed Pumping Irrigation
Saltvisi Proposed Gravity Irrigation

Attachment 7: Request letter from Ltd "Mtkvari-M".

Letter from Ltd "Mtkvari-M":

Regarding the Project for Rehabilitating Tiriponi and Saltvis Irrigation systems

Gori Service Centr of Ltd "Mtkvari-M" appeals to consider proposals listed below and provide assistance.

After rehabilitating Tiriponi and Saltvisi main channels the company needs to purchase vehicles and special equipments for further maintenance and operation:

1. Excavator on wheels with 156 horse power and 6 m long boom.
2. Excavator on wheels with 100 horse power.
3. Tractor on wheels with 100 horse power and with trailer.
4. Half truck type vehicle.
5. Two all-terrain vehicles.
6. Two SUVs.
7. Equipment for channel cut with 35 cm width.
8. Small sized Welding equipment with internal combustion engine. We also consider repairing of two vehicles with trademarks "KAMA3" and "MA3" and repairing of crane which are the property of "Mtkvari - M".

It should be mentioned as well, that Ltd "Mtkvari-M" is signing a contract with settlers for supplying irrigation water. For this reason, settlers have to walk or drive 35-40 km away in city Gori where Ltd "Mtkvari-M" Service Centre is located. Due to lack of finances the company can't afford to open other Service Centers. Gori Service Center asks for your assistance in scope of your capability, to open new Service Centers for settlers in vil. Shindisi which is supplied by Saltvisi main and Zeda Ru channels and in the villages: Tkviavi and Mejvriskhevi which get irrigation water from Tiriponi main channel. Also we are asking you to purchase office furniture for Gori Service Centers in scope of your capability.
To our mind in case of considering our proposals, supply of population with irrigation water and operational capacity of Ltd "Mtkvari-M" will be improved significantly.

Employees of Ltd "Mtkvari-M"

Manager of Gori Service Centre: Mamuka Lomsadze

Attachment 8: GPS Points & Google Map

Tiriponi Irrigation System

Point	Longitude (X)	Latitude (Y)	Place
1	422766	4671768	Karbi headwork on the river Patara Liakhvi.
2	422787	4671757	
3	417242	4671845	Main channel
4	417231	4671825	
5	422705	4671523	Syphon on the river Patara Liakhvi
6	423265	4671476	Bridge on the channel
7	423244	4671471	Headwork of outlet with distribution well on G-2
8	424857	4671145	Syphon on Charebula gorge, with two 42 m long reinforce concrete pipes
9	424898	4671142	
10	425853	4670910	Reinforced flume on the channel for pedestrians
11	427747	4668422	Syphon on Bobona gorge with threads
12	427759	4668402	
13	428381	4667476	Headwork for two outlets
14	428361	4667475	
15	429330	4666845	Aqueduct on Arceule gorge, bordering the occupied area
16	427015	4666840	The structure is located at the border of occupied territory
17	434684	4666073	Syphon on the river Mejuda with two 474 m long reinforced concrete pipes
18	434868	4666021	The same syphon; the part of the syphon which is supported by piers.
19	435109	4665942	The same syphon, inlet structure and initial part of a new tunnel
20	435895	4664364	Exit of the channel (281+79) joined with the gallery with 75 m of length
21	435805	4664260	which is connected to the new syphon (282+31)
22	435900	4664226	
23	438418	4661823	518 m long syphon at the end of the channel which joins the tunnel at
24	438600	4661525	325+45
25	439425	4661037	Exit of the tunnel at 333+45. Tunnel (800 m of length) joins 16 m long
26	439438	4661027	concrete flume
27	439775	4660765	
28	417768	4671536	Distribution channels
29	417690	4671436	
30	423244	4671471	G – 2
31	423242	4671316	
32	428381	4667476	G – 3
33	428361	4667475	
34	428281	4667349	
35	428281	4667349	Broken bridge at the road crossing
36	428017	4666976	G – 3 - 1

Saltvisi Irrigation System

Point	Longitude (X)	Latitude (Y)	Place
47	414023	4672194	Main channel.
48	414018	4671631	The bridge, outlet.
49	413812	4671432	The bridge, vil. Zemo Khviti
50	413602	4671345	The bridge, the section is filled with soil, rocks and sediment.
51	411699	4665517	The bridge on G – 2, vil. Khelqceuli
52	413992	4665056	The new channel at the exit of the vil. Khelqceuli, culvert, earth channel.

Tiriponi-Saltvisi Irrigation System 52 GPS Points

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Attachment 9: Photos

320 -

Tiriponi main channel; Aqueduct on Adzura gorge, DM 229+61 – 230+17; Border zone

704 - Additional supply for Tiriponi main channel; Karbi Headwork's on the river Patara Liakhvi; the dam with gates

709 - Additional supply for Tiriponi main channel; Karbi Headwork on the river Patara Liakhvi; water intake

711 - Tiriponi main channel, syphon on the river Patara Liakhvi, DM 95+20 – 100+18; exit bulkhead

712 - Tiriponi main channel; the bridge on the channel, DM 123+80

715 - Tiriponi main channel; G-2 distribution channel, DM 103+76; distribution well of headwork

716 - Tiriponi main channel; Syphon on Charebula gorge, DM 120+45 – 120+87; exit bulkhead

721 - Tiriponi main channel; reinforced concrete flume on the channel for pedestrians, DM 132+17

724 - Tiriponi main channel; G-2 outlet, DM 103+76; rehabilitation channel

726 - Tiriponi main channel; G-2 outlet, DM 103+76; rehabilitation culvert

732 - Tiriponi main channel; point where pressure pipe directed form the pumping station joins in the main channel, DM 37+36; connection with the existing gallery

733 - Tiriponi main channel; point where pressure pipe directed form the pumping station joins in the main channel, DM 37+36; connection with the existing gallery

735 - Tiriponi main channel; DM 37+36; new water distribution pipe connected with pressure pipe

737 - Tiriponi main channel; syphon on Bobona gorge, DM 168+33 – 1168+52; exit bulkhead

738 - Tiriponi main channel; headwork for two outlets, DM 181+03; first for energy supply and second for irrigation – headwork of G-3

741 - Tiriponi main channel; headwork for two outlets, DM 181+03; water retaining structure in the channel

743 - Tiriponi main channel; headwork for two outlets, DM 181+03, damaged section on the left side of the channel

750 - Tiriponi main channel; G-3 distribution channel, broken bridge at the road crossing

790 - Tiriponi main channel; aqueduct at Arceula gorge with steel pipes, DM 209+85 – 210+09; border zone; view from the village

795 - Tiriponi main channel; aqueduct on Arceula gorge with steel pipes, DM 209+85 – 210+09; border zone; view across the river flow

797 - Tiriponi main channel; G-3-1 distribution channel; water intake from distribution channel; DM 6+20

803 - Tiriponi main channel; G-3-1 distribution channel; rehabilitation channel and culvert

806 - Tiriponi main channel; G-3-1 distribution channel; rehabilitation channel, service road is cut off

814 - Tiriponi main channel; G-1 distribution channel; water intake from the main channel

815 -Tiriponi main channel; G-1 distribution channel; the pipe, arranged under the road

816 - Tiriponi main channel; G-1 distribution channel; lined channel

821 - Saltvisi main channel; point where gallery arranged in main channel gets water from pressure pipe, DM 41+05

824 - Saltvisi main channel; point where gallery arranged in main channel gets water from pressure pipe, DM 41+05

828 - Saltvisi main channel; Initial section at the village Zemo Nikozi

830 - Saltvisi main channel; Initial section at the village Zemo Nikozi; the bridge on the channel

837 - Saltvisi main channel; channel at the exit of the village Kelqtseuli

847 - Tiriponi main channel; syphon on the river Mejuda, DM 259+53 – 264+27; entrance of the syphon with bulkhead spillway

848 - Tiriponi main channel; syphon on the river Mejuda, DM 259+53 – 264+27

849 - Tiriponi main channel; syphon on the river Mejuda, DM 259+53 – 264+27; bulkhead of syphon, DM 259+53 – 264+27

853 - Tiriponi main channel; syphon on the river Mejuda, DM 259+53 – 264+27; part of the syphon on piers, which goes through the river-bed

860 - Tiriponi main channel; syphon on the river Mejuda, DM 259+53 – 264+27, open section

868 - Tiriponi main channel; exit of the tunnel combined with the gallery, DM 281+79; which is combined with a new syphon, DM 282+31; the village gets water from the broken gallery and syphon

870 - Tiriponi main channel; exit of the tunnel combined with the gallery, DM 281+79; which is combined with a new syphon, DM 282+31; the village gets water from the broken gallery and syphon

878 - Tiriponi main channel; syphon at the end of the channel, DM 320+25 – 325+43; the syphon joins the tunnel, DM 325+45

879 - Tiriponi main channel; syphon at the end of the channel, DM 320+25 – 325+43; the syphon passes into the tunnel, DM 325+45; water flows out from the short pipe for G-5; water damages the foundation

880 - Tiriponi main channel; syphon at the end of the channel, DM 320+25 – 325+43; the syphon passes into the tunnel, DM 325+45; the wall of exit bulkhead is damaged


Tskhinvali
Zemo Korkula
Shua Makhisi
Zemo Bikari
Karbi
Brotsleti
Andoreti
Akhrisi
Google earth